Frontispiece.

Robert Fulton.

ROBERT FULTON

[illegible] STEAM NAVIGATION

[illegible]

NEW YORK & LONDON
G. P. PUTNAM'S SONS
The Knickerbocker Press
1887

THE LIFE

OF

ROBERT FULTON

AND A

HISTORY OF STEAM NAVIGATION

BY

THOMAS W. KNOX

AUTHOR OF

"THE TRAVELS OF MARCO POLO," "THE BOY TRAVELLERS IN SOUTH AMERICA," "THE BOY TRAVELLERS IN THE FAR EAST," FIVE VOLS.; "THE YOUNG NIMRODS," TWO VOLS.; "THE VOYAGE OF THE VIVIAN," "OVERLAND THROUGH ASIA," "BACKSHEESH," "UNDERGROUND," "JOHN," "CAMP-FIRE AND COTTON-FIELD," "HOW TO TRAVEL," "THE POCKET GUIDE AROUND THE WORLD," ETC., ETC.

ILLUSTRATED

NEW YORK & LONDON
G. P. PUTNAM'S SONS
The Knickerbocker Press
1887

Press of
G. P. Putnam's Sons
New York

PREFACE.

IN the belief that a history of steam navigation, combined with a biography of the man who designed and built the first successful steamboat, would be of general interest, the author has prepared this volume. He has avoided the use of technical terms wherever possible, in order that the work might prove acceptable to youthful, or non-scientific readers, as well as to those with whom steam navigation is a special study.

The materials for the life of the inventor have been drawn from many sources. The author acknowledges his indebtness to the biographies of Fulton, by Colden, Renwick, and Reigart, to "Life and Letters of Joel Barlow," by Charles Burr Todd, and also to the officers of the New York Historical Society, for the use of records in their possession. In the history of steam navigation, he has been greatly aided by the work of Admiral Preble upon the same subject; by Professor Thurston's "History of the growth of the steam engine," Bourne's "Catechism," King's "Practical notes for Students and Engineers," and by other books of similar nature. The illustrations referring especially to Robert Fulton, are mainly reproduced from Mr. Reigart's biography; they were made originally from drawings by Fulton and now in the possession of his descendants. The other illustrations are from sources which are a guaranty for their accuracy.

Hoping for a favorable reception by press and public the author submits the result of his efforts for their examination.

T. W K.

NEW YORK, 1886.

CONTENTS.

CHAPTER VI.

CHAPTER VII.

CHAPTER VIII.

CHAPTER IX.

CHAPTER X.

CHAPTER XI.

CHAPTER XXII.

LIST OF ILLUSTRATIONS.

Robert Fulton, senior, had three daughters and two sons; Robert, junior, was the eldest son and third child. The father sold the farm in Little Britain in 1766 and returned to Lancaster, where he died two years later. His wife survived him nearly a third of a century; she died in 1799, on a small farm in Washington County, Pennsylvania, which had been bought by her son Robert thirteen years earlier.

Down to his eighth year Robert was educated at home. His mother taught him to read and write, but his accomplishments in chirography were limited to little more than "pot-hooks and trammels." He had also a slight knowledge of arithmetic, and very early in life he showed an aptness for drawing. In 1773 he was sent to school in Lancaster, where he was taught by Caleb Johnson, a dignified Quaker, who soon pronounced young Fulton a dull pupil. He was backward with his lessons and frequently reproved, but it was soon ascertained that he was by no means idle. He cared less for books than for his pencil, and during the time allotted to recreation he often spent hours over drawings.

He had a fondness for the shops of the mechanics, where he was heartily welcomed; with his taste for drawing and his quickness in mechanical work, he often rendered practical aid to persons much older than himself.

A few anecdotes of his school-days are preserved in the histories and traditions of Lancaster. One day his teacher reproved him for neglecting his books, and the reproof was administered after the manner of "the old masters,"—with a ferule on the knuckle. Robert straightened himself, folded his arms, and then said to Mr. Johnson: "Sir, I came here to have something beat into my head and not into my hand."

On another occasion he came late, and when the teacher asked the reason, Robert answered that he had been at Mr. Miller's shop pounding out lead to make a pencil. In proof of his statement he exhibited the pencil and said it was the best he ever had in his life; Mr. Johnson approved it and gave the youth some words of encouragement, and in a few days nearly all the other pupils were supplied with pencils of the same kind. It is said that when Mr. Johnson once urged him to give more attention to his studies, the boy answered that his head was "so full of original notions that there was no room to store away the contents of dusty books." As he did not spend his time in idleness there is no doubt of the sincerity of his statement, and his devotion to mechanical works shows what was the natural bent of his mind.

In 1778, when Robert was thirteen years old, the following notice was published in Lancaster:

"The excessive heat of the weather, the present scarcity of candles, and other considerations, induce the council to recommend to the inhabitants to forbear illuminating the city on Saturday evening next, July 4th.

"*By order,*

"(Signed) TIMOTHY MATLACK, Sec."

Like other patriotic youths, Robert had prepared for the illumination, and had a quantity of candles ready. As soon as the notice appeared he went to the shop of Mr. Fisher and asked to exchange his candles for powder. Mr. Fisher asked why he wished to part with the candles, which were scarce and dear. The youth answered that he was a good citizen and wanted to respect the request of the authorities, who did not wish the streets and windows illuminated. He would not use the candles for the purpose they were originally intended, but preferred illuminating the heavens with sky-rockets.

After obtaining the powder, he bought some sheets of pasteboard at another shop (kept by Mr. Cossart), and asked that the sheets might be left open as he wished to roll them in his own way. In answer to a question by Mr. Cossart, as to what he intended doing with the pasteboard, he made the same explanation that he had already given to Mr. Fisher.

The pasteboard-dealer laughed, and said it was an impossibility to shoot candles through the air in the way he proposed.

"No, sir," Robert answered, "there is nothing impossible."

He made the rockets, which were fairly successful, and succeeded in astonishing some of the good people of Lancaster, who had never seen any thing of the kind.

Mr. Reigart, one of his biographers, tells the following:

"Robert was known to purchase small quantities of quicksilver from Dr. Adam Simon Kuhn, druggist, residing opposite the market-house. He was trying some experiments that he did not wish to make public, and which the workmen in Mr. Fenno's and Mr. Christian Isch's shops were anxious to find out, but could not. He was in the almost daily habit of visiting those shops (Mr. Isch's smithshop was then located on the northeast corner of West King and Prince streets), and was a favorite among the workmen, who took advantage of his talent for drawing by getting him to make ornamental designs for guns, and sketches of the size and shapes of guns, and then giving the calculations of the force, size of the bore and balls, and the distance they would fire; and he would accompany them to the open commons near by Potter's Field, to prove his calculation by shooting at a mark. On account of his expertness in his calculations, and on account of their ineffectual efforts to discover the use he was making of quicksilver, the shop-hands nicknamed him 'Quicksilver Bob.'

"Mr. Messersmith and Mr. Christian Isch were employed by the government to make and repair the arms for the troops, and on several occasions guards were stationed at their shops to watch and see that workmen were constantly employed during whole nights and on Sunday, to prevent any delay. The workmen had so much reliance and confidence in 'Quicksilver Bob's' judgment and mechanical skill, that every suggestion he would make as to the alteration of a gun, or any additional ornament that he would design, were invariably adopted by common consent.

"In the summer of 1779, Robert Fulton evinced an extraordinary fondness for inventions. He was a frequent visitor at Mr. Messersmith's and Fenno's gunsmith shops almost daily, and endeavored to manufacture a small air-gun. One of Mr. Jacob Messersmith's apprentices, Mr. Christopher Gumpf, who was at the time eighteen years of age, used frequently to accompany his father, Deter Gumph, to the Conestoga on fishing excursions, Mr. Deter Gumpf being an experienced angler, and very fond of fishing, and he was pleased to have the company of Christopher and Robert. The old gentleman had a small flat-boat, which he had kept secured to the trunk of a tree by a chain and padlock, for his own accommodation. He generally required the boys to pole the boat to different parts of the creek in the neighborhood of Rockford, the country-seat of General Hand, which at that time was the most secluded, deeply shaded, and quiet neighborhood along the Conestoga. Returning homeward one evening, Fulton observed to Christopher that he was very tired using that pole, and Christopher coincided with him that the labor was too severe.

"Robert absented himself a week, having gone to Little Britain township to spend a few days at his aunt's; and while there he planned and completed a small working model of a fishing-boat with paddle-wheels. On leaving his aunt's, he placed the model in the garret with the request that it should not be destroyed. Many years

Fulton's First Experiment with Paddle-Wheels.

afterwards, that simple model was the attraction of friends, and became, instead of lumber in the garret, an ornament in the aunt's parlor, who prized it highly. That model was the result of Robert's fishing excursions with Christopher Gumpf; and when he returned from his aunt's he told Christopher that he must make a set of paddles to work at the sides of the boat, to be operated by a double crank, and then they could propel the old gentleman's fishing-boat with greater ease. Two arms or pieces of timber were then fastened together at right angles, with a paddle at each end, and the crank was attached to the boat across it near the stern, with a paddle operating on a pivot as a rudder; and Fulton's first invention was tried on the Conestoga River opposite Rockford, in the presence of Deter and Christopher Gumpf. The boys were so pleased with the experiment, that they hid the paddles in the bushes on the shore, lest others might use and break them, and attached them to the boat whenever they chose; and thus did they enjoy very many fishing excursions."

Other anecdotes show that the old adage, "the boy is father of the man," was illustrated in young Fulton's case. He was constantly occupied with mechanical projects, some of them quite visionary in their character and others of practical value, while his skill in drawing kept his pencil in active use. His boyhood was in the time of the Revolutionary war, and, according to the tradition, Fulton was a most ardent American. He had a genius for caricature, and employed it in making grotesque sketches of the Hessian soldiers, who were stationed in Lancaster for the protection of the Tory inhabitants and the suppression of the patriots. In the neighborhood of the camping ground there was generally quite an assemblage of the towns-people. Daily about sunset, and very often, there were fights between the Whig and Tory boys. These collisions became so frequent that a rope was stretched across the street as a sort of neutral line, and if either party ventured beyond the boundary there was sure to be trouble.

Robert made a sketch of the spot and drew upon his imagination sufficiently to represent the rebel boys crossing the rope and thrashing the Tories. When his picture was complete he showed it in the workshops, where it attracted much attention. It did more, as it gave a hint to the rebels which they proceeded to act upon. The very next evening after the exhibition of the sketch, they jumped the rope and brought on a fight of such a serious character that the town authorities interfered and prohibited all gatherings of the same kind in future. The instigator of the performance did not have an active hand in it—not from any personal reluctance, but because he had promised his mother he would not. A few of his sketches at this period are still in existence, but the most of them fell into Tory hands and were destroyed.

As he advanced in years it became necessary for young Fulton to choose a permanent occupation. He was more fond of the pencil and brush than of any thing else, and his ambition turned him in the direction of art. The celebrated American painter, Benjamin West, was a native of the county adjoining the one in which Fulton was born, and his father was an intimate friend of Robert Fulton, senior. At the time of which we write West had become famous, and there is little doubt that his success had much to do with the bent of young Fulton's mind.

He too determined to be an artist, and at the age of seventeen he left Lancaster for Philadelphia, where he hoped to perfect himself in the technical knowledge requisite for success, as he had the good sense to understand that he could not depend entirely upon his natural abilities. He was industrious and painstaking, and his industry was rewarded. He made many friends, among them Benjamin Franklin and other men of prominence, and through these friends his occupation became remunerative in the first year of his stay in the Quaker City. He painted portraits and landscapes, made drawings of machinery, buildings, carriages, and performed, in fact, pretty nearly all artistic work that came to him.

In the four years between his seventeenth and his twenty-first birthday he not only supported himself, but sent occasional remittances to his mother and sisters, and at their urgent invitation decided to spend the date of his majority at home. How much money he had saved from his earnings is not known, but he certainly had accumulated enough for the purchase of a farm in Washington County, for which he paid eighty pounds (four hundred dollars), a considerable amount for those days. The document by which this property was conveyed is still in existence, and reads as follows:

"KNOW ALL MEN BY THESE PRESENTS, that I, Thomas Pollock, and Margaret, his wife, of the township of Hopewell, county of Washington, and State of Pennsylvania, for and in consideration of the sum of eighty pounds, lawful money of the State aforesaid, to me in hand paid by Robert Fulton, miniature painter, of the city of Philadelphia, and State aforesaid, yeoman, before the sealing and delivery of these presents, the receipt whereof we do hereby acknowledge, and ourselves therewith fully satisfied, contented, and paid, have granted, bargained, sold, and confirmed, and by these presents do grant, bargain, sell, make over, and confirm unto the aforesaid Robert Fulton, to his heirs and assigns—

"A certain parcel of land on the waters of Cross creek, it being part of a tract of land granted by the Commonwealth of Pennsylvania, the 12th day of December, A.D. 1785, to the Rev. Joseph Smith, his heirs and assigns, called Wiliome, situated on the waters aforesaid, in the county aforesaid, BEGINNING at a corner white-oak, thence by other lands of the said Joseph Smith south eighty-five degrees, west forty-six perches to a white-oak on the Wheeling path, thence north thirty-two degrees, west eighteen perches to a post, thence south sixty-eight degrees, west one hundred and thirty-seven perches to a dogwood tree, thence north thirty degrees, west one hundred and fifty perches to a stump and hickory tree, thence south thirty degrees, west two hundred perches to the place of Beginning—CONTAINING eighty-four (84) acres and three-fourths of an acre—

"With the appurtenances (which said land was formerly surveyed and platted by a certain John Hale for a certain Thomas Gardner, afterwards surveyed with a tract of land in pursuance of a warrant granted to the said Joseph Smith, dated the 30th day of September, 1785, and conveyed by said Joseph Smith and Esther his wife to Thomas Pollock)—To have and to hold the tract or parcel of land, with the appurtenances, unto the said Robert Fulton and his heirs, to the use of him, the said Robert Fulton, his heirs and assigns, for ever, free and clear of all restrictions and reservations as to mines, royalties, quit-rents, or otherwise, excepting and reserving only the fifth part of all gold and silver ore for the use of this Commonwealth, to be delivered at the pit's mouth clear of all charges.

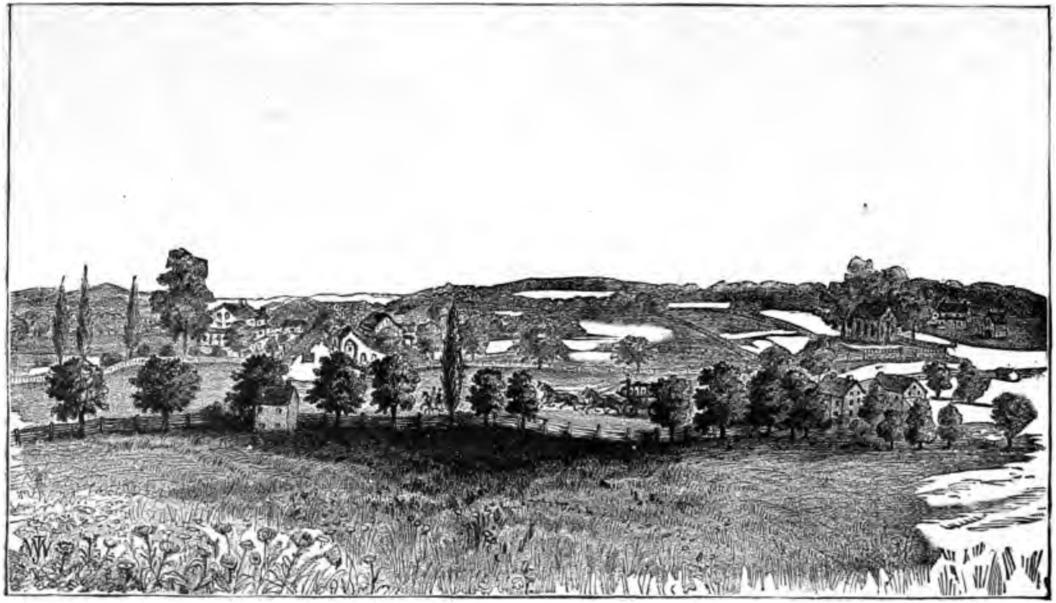
"In witness whereof we have here set our hands and caused our seals to be affixed, the 6th day of May, A.D. 1786.

"THOMAS POLLOCK, [L.S.]
"MARGARET POLLOCK, [L.S.]

"Signed, sealed, and delivered in the presence of

"J. MARSHAL,
"MARY MARSHAL,
"THOMAS MARQUES."

A copy of this paper can be seen in the Recorder's office in and for the county of Washington, in Record Book C, vol. i., page 56, May 8, 1786.



Fulton Farm, Washington County, Pennsylvania.

Mrs. Fulton resided on the farm until her death. The property remained in the name of Robert Fulton, but he never lived there. His sister, Mrs. Elizabeth Scott, occupied the place and received it by will from her brother, together with all the live stock and portable property appertaining to it.

CHAPTER II.

Fulton goes to England—West's patronage and friendship—Duke of Bridgewater and Earl Stanhope — West and his works— Fulton on canal navigation—His engineering work in England—His inventions—The Erie Canal.

IN the preceding chapter we have brought the history of Robert Fulton down to the time when he attained his majority and commemorated the event by giving a home to his mother. Immediately after buying the farm in Washington County, he moved the family to it and after seeing them comfortably settled returned to Philadelphia. On his way there he stopped a short time at a mineral spring for the benefit of his health, which was somewhat broken in consequence of pulmonary troubles, which his friends attributed to his close application to his profession.

Partly with a view to the restoration of his health and partly because of his ambition to make a name in the artistic world, he decided upon a voyage to Europe, a momentous undertaking for those times. He had already corresponded with Benjamin West, who promised to aid him with patronage and advice, and he carried letters to several prominent Americans then in London and Paris. West was as good as his promise; he was so well pleased with his compatriot that he introduced him into society, and took him into his own family where, according to his biographer, he remained "several years," but the exact period is not stated.

West painted Fulton's portrait, which is now in possession of his family, but is not considered one of the best works of the famous artist. Through the introductions obtained by his countryman, and the advantage of his instruction, Fulton had plenty of employment. Portraits and landscapes painted by him at this period are to be found in several of "the stately homes of England," and he counted among his friends the Duke of Bridgewater, Lord Stanhope, and other titled personages. Through all his artistic studies and work, he never lost his taste for mechanics and engineering, and his time was divided between painting and engineering during a large part of his stay abroad. His friendship for the noblemen named above was in consequence of his engineering abilities rather than his skill with the brush.

Francis Egerton Bridgewater, second and last duke of that name, was the owner of extensive coal mines at Worsley, and his fame rests upon his achievements in causing the construction of a navigable canal from Worsley to Manchester, which was afterwards extended to connect the rivers Trent and Mersey. Charles Earl Stanhope, (the third of that title) was the inventor of the Stanhope printing-press, and devoted much time to the study of mechanics and engineering.

He suggested several improvements in canal locks, and it was in connection with canals and their improvement that he became intimate with Fulton. They kept up a steady correspondence after Fulton left England, and frequently exchanged ideas on the subject in which both were greatly interested. It must be remembered that the railway had not then been invented, or at any rate was practically unknown, and the canal was regarded as the cheapest route of transportation. Canals or artificial waterways had been in use in Europe and Asia for hundreds of years, but they probably received their greatest development in the century immediately preceding the invention of the steam railway.

During his residence in England Mr. Fulton, possibly at the suggestion of Mr. West and certainly with his approval, suggested that the citizens of Philadelphia should purchase the paintings of the latter and found an institute of fine arts to encourage the study of painting and sculpture. Accompanying the letter containing the proposal, Mr. Fulton sent a list of all of Mr. West's paintings, portraits excepted, and said they could be bought for fifteen thousand pounds sterling. Considering the prices subsequently obtained by Mr. West for single pictures in the collection, the offer was exceedingly liberal, and the investment would have been a very profitable one for the City of Brotherly Love. Fulton suggested measures for raising the necessary funds for the purchase, but no attempt was made to carry out his plans.

In view of the intimacy between Fulton and West, a few words concerning the latter will be of interest.

Benjamin West was born in Springfield, Pennsylvania, in 1738, and died in London in 1820. In his seventh year he began to make colored drawings from nature and when he was nine years old he painted a picture which he regarded sixty-seven years later as unsurpassed in certain particulars by any of his subsequent works. He went to Europe in 1760, and in 1768 took up his residence in London, where he passed the rest of his life. He soon became famous, and, during his artistic career, painted or sketched about four hundred pictures, besides leaving more than two hundred drawings at the time of his death. Battle, historical, and religious pieces were his specialties. Some of his most remarkable works were, "The Death of General Wolfe," "Agrippina Landing with the Ashes of Germanicus," "Christ Healing the Sick," "Death on the Pale Horse," and "The Battle of La Hague."

The "Death of Wolfe" was painted in the costumes of the period, contrary to the advice of all the eminent artists of the day. Down to that time

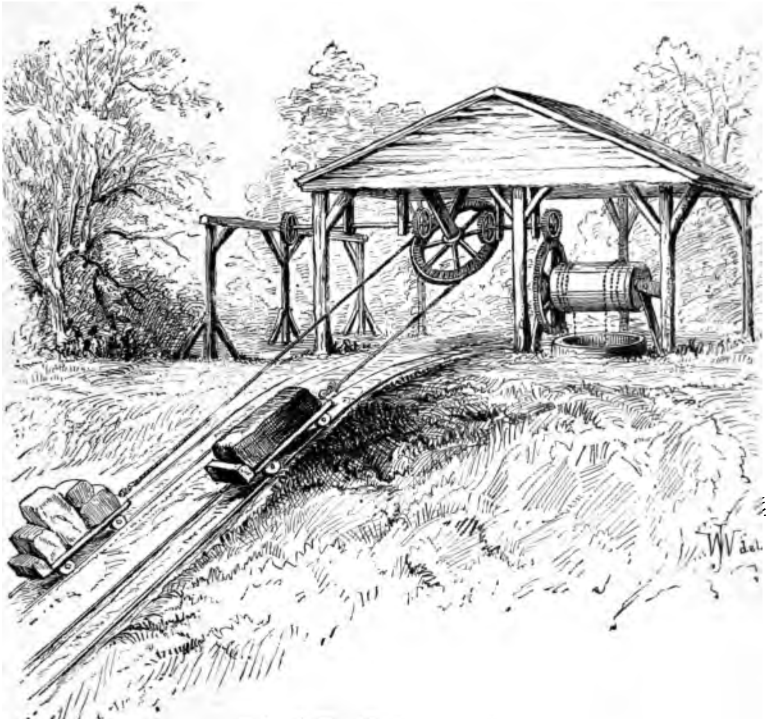
British artists had not dared to abandon classical garments in painting their great pictures, and the experiment of West was considered hazardous in the extreme. Sir Joshua Reynolds advised against it, but afterwards came to West and complimented him on his success. In 1792 West succeeded Sir Joshua Reynolds as President of the Royal Academy, and declined the honor of knighthood. He held the position ten years and then retired, but was reëlected in 1803 and retained the honor until his death.

Mr. West was noted for the advice, patronage, and friendly aid which he gave to young artists, and his treatment of Fulton was no exception to his general course. It is possible that his struggles at the beginning of his career may have caused him to regard aspirants for honors with a kindly eye. He made his first brushes out of hair taken from a cat's tail, and his colors were made from leaves, berries, soot, and any thing else that was attainable. His earliest picture was drawn with red and black ink, and represented his sister's child sleeping in a cradle, and his first instruction in mixing colors was obtained from some Indians who made a yearly visit to his native town. At the age of sixteen he was painting portraits in the towns and villages around Philadelphia, and, at the suggestion of a gunsmith, he composed and painted "The Death of Socrates."

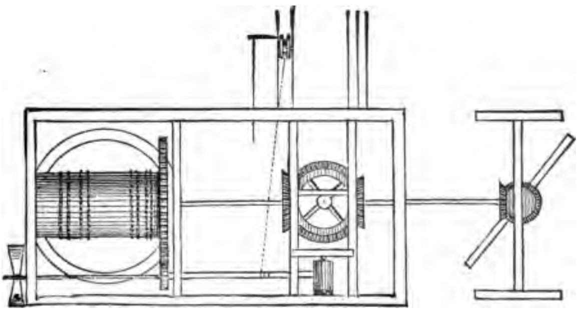
West's parents were Quakers, and the Society of Friends did not take kindly to the idea of his becoming a painter. They held a public meeting to discuss the matter, and finally gave their consent. One of his first pictures after this event was "The Treaty of William Penn with the Indians," and it probably more than repaid his Quaker relatives and friends for the condescension. From the age of sixteen until he went abroad, he painted portraits in Philadelphia and New York, and, in the latter city, he received the encouragement which sent him to Italy.

During his residence in England Mr. Fulton published a treatise on canal navigation, and as early as 1793 he had conceived the idea of propelling vessels by steam, which is repeatedly mentioned in his manuscripts of that time. In the following year he obtained a patent from the British Government for a double inclined-plane for raising and lowering boats from one level to another on a system of small canals which he had planned. The object of his treatise on canal navigation was to show that small canals without expensive locks, and navigated by boats of limited dimensions, were preferable to large canals, and could be made through many sections of country where extensive works would be unremunerative.

By means of the double inclined-plane he proposed to raise or lower a boat without disturbing



Fulton's Double Inclined-Plane.



Details of Double Inclined-Plane.

its cargo. To accomplish this, he made use of water introduced into coffers from the higher levels, so that the weight of the laden boat would be more than counterbalanced, in much the same way that elevators are now operated in many buildings in New York and other cities.

He also applied the power of water to turbine and other wheels connecting with a revolving drum around which the cable attached to the boat was carried. By the power of the wheel a laden boat could be carried up while an empty one was descending the other. He did not claim that the entire idea was a novel one, but his patent was obtained on certain parts of the machinery, and especially on the coffer, which was made to move in a perpendicular shaft or well.

His book was not restricted to canals, but included improvements in bridges and aqueducts. Before publishing it Mr. Fulton submitted his plans and the models of the machines to Sir John Sinclair, President of the British Board of Agriculture, by whom it was laid before that honorable body. The board passed a resolution endorsing the publication in complimentary terms, and the treatise is said to have been favorably received by engineers and others interested in public works. His patent for double inclined-planes was issued May 8, 1794.

Immediately on the publication of his book he sent copies to the President of the United States, the Secretary of the Treasury, and to the Governor of the State of New York, and accompanying each copy was a letter setting forth the advantages of canals to the prosperity of the United States. In his letter to the governor he advocated the system of canals in preference to turnpike-roads for interior communications, and he recommended his own system of small canals and inclined planes. The books and letters were acknowledged by their recipients, but they do not seem to have attracted much attention in the United States until more than ten years later, when Fulton had returned to his native land and was busy with his projects of steam navigation. In 1807, Mr. Gallatin, who was then Secretary of the Treasury, wrote to Mr. Fulton, asking for information which he desired to embody in his report to Congress on public roads and canals. In response to the Secretary's inquiry Mr. Fulton set forth his views at considerable length, and his letter was made a part of the official report.

After giving an estimate of the cost of a canal constructed upon his system, its carrying capacities, the cost of transportation, the rate of speed, the advantages to people living near it, etc., etc., Mr. Fulton wrote as follows:

"Having thus, in some degree, considered the advantages which canals will produce in point of wealth to individuals and the nation, I will now consider their importance to the Union, and their political consequences.

"First, their effect on raising the value of the public lands, and thereby augmenting the revenue.

"In all cases where canals shall pass through the lands of the United States, and open a cheap communication to a good market, such lands will rise in value for twenty miles on each side of the canal. The farmer who will reside twenty miles from the canal can, in one day, carry a load of produce to its borders; and were the lands six hundred miles from one of our seaport towns, his barrel of flour, in weight two hundred pounds, could be carried that distance for sixty cents, the price which is now paid to carry a barrel fifty miles on the Lancaster turnpike. Consequently, as relates to cheapness of carriage and easy access to market, the new lands, which lie six hundred miles from the seaports, would be of equal value with lands of equal fertility, which are fifty miles from the seaports. But, not to insist on their being of so great a value, until population is as great, it is evident that they must rise in value in a three or fourfold degree; every lineal mile of canal would accommodate 25,600 acres; the lands sold by the United States in 1806 averaged about two dollars an acre, and certainly every acre accommodated with a canal would produce six dollars; thus, only twenty miles of canal, each year, running through national lands, would raise the value of 512,000 acres of land at least four dollars an acre, giving two million and forty-three dollars to the treasury,—a sum sufficient to make one hundred and thirty-six miles of canal. Had an individual such a property, and funds to construct canals to its centre, he certainly would do it for his own interest. The nation has the property. And the nation possesses ample funds for such undertakings.

"Second, on their effect in cementing the Union, and extending the principles of confederated republican government, numerous have been the speculations on the duration of our Union, and intrigues have been practised to sever the Western from the Eastern States. The opinion endeavored to be inculcated was, that the inhabitants behind the mountains were cut off from the market of the Atlantic States; that, consequently, they had a separate interest, and should use their resources to open a communication to a market of their own; that, remote from the seat of government, they could not enjoy their portion of advantages arising from the Union, and that, sooner or later, they must separate and govern for themselves.

"Others, by drawing their examples from European governments, and the monarchies which have grown out of the feudal habits of nations of warriors, whose minds were bent to the absolute power of the few, and the servile obedience of the many, have conceived these States of too great an extent to continue united under a republican form of government, and that the time is not distant when they will divide into little kingdoms, retrograding form common-sense to ignorance, adopting all the follies and barbarities which are every day practised in the kingdoms and petty states of Europe. But those who have reasoned in this way have not reflected that men are the creatures of habit, and that their habits as well as their interests may be so combined as to make it impossible to separate them without falling back into a state of barbarism. Although in ancient times some specks of civilization have been effaced by hordes of uncultivated men, yet it is remarkable that since the invention of printing, and general diffusion of knowledge, no nation has retrograded in science or improvements; nor is it reasonable to suppose that the Americans, who have as much if not more information in general than any other people, will ever abandon an advantage which they have once gained. England, which at one time was seven petty kingdoms, has, by habit, long been united into one. Scotland, by succession, became united to England, and is now bound to her by habit, by turnpike-roads, canals, and reciprocal interests. In like manner all the counties of England, or departments of France, are bound to each other; and when the United States shall be bound together by canals, by cheap and easy access to markets in all directions, by a sense of mutual interest arising from mutual intercourse and mingled commerce, it will be no more possible to split them into independent and separate governments, each lining its frontiers with fortifications and troops, to shackle their own exports and imports to and form the neighboring States, than it is now possible for the government of England to divide and form again into seven kingdoms. But it is necessary to bind the States together by the people's interest, one of which is to enable every man to sell the produce of his labor at the best market, and purchase at the cheapest. This accords with the idea of Hume, 'that the government of a wise people would be little more than a system of civil police; for the best interest of man is industry, and a free exchange of the products of his labor for the things which he may require.'

"On this humane principle, what stronger bonds of union can be invented, than those which enable each individual to transport the produce of his industry 1,200 miles for sixty cents the cwt.? Here, then, is a certain method of securing the union of the States, and of rendering it as lasting as the continent we inhabit.

"It is now eleven years that I have had this plan in contemplation for the good of our country. At the conclusion of my work on small canals, there is a letter to Thomas Mifflin, then Governor of the State of Pennsylvania, on a system of canals for America. In it I contemplated the time when 'canals should pass through every vale, wind around every hill, and bind the whole country together in the bonds of social intercourse,' and I am happy to find that, through the good management of a wise administration, a period has arrived when an overflowing treasury exhibits abundant resources, and points the mind to works of such immense importance. Hoping speedily to see them become favorite objects with the whole American people,

"I have the honor to be,

"Your most obedient servant,

"ROBERT FULTON."

It is claimed for Mr. Fulton that he never made a model until he had first completed a careful drawing in which every part was shown in detail and projected on the proper scale. In every thing relating to canals and roads his specifications were voluminous and covered all the features of the proposed work. It is quite likely that his enthusiasm sometimes carried him into theories that were not altogether borne out by facts as subsequently developed, but in this respect he was not unlike certain engineers of later days.

Mr. Reigart, his biographer, claims that the earliest notice of the desirability of opening a communication between the Hudson River and Lake Erie was in a letter which Mr. Fulton sent to the government in 1807 in answer to an inquiry concerning a projected canal between the Mississippi River and Lake Pontchartrain. It is hardly probable, however, that Fulton was the originator of the Erie Canal project, though there can be little doubt that his advocacy of the enterprise may have advanced it.

In the spring of 1810 the Legislature of New York appointed commissioners to examine the route and report upon the feasibility of the work. They reported in the following year, when Mr. Fulton was added to the commission, and in 1812 a second report was made.

In 1814 he addressed a long letter to the president of the commission, in which he set forth the advantages of the proposed canal and the great difference between the cost of transportation in boats and that of the old method by wagons. He estimates that on a canal goods can be carried one hundred miles for one dollar a ton, while the usual cost of wagoning was one dollar and sixty cents per hundredweight for one hundred miles, or thirty-two dollars a ton. "It consequently follows," said he, "that on a canal a ton weight could be boated three thousand two hundred miles for the sum now paid to wagon it one hundred miles, and the persons at three thousand two hundred miles from a good seaport would have all the advantages of trade, or of bringing their produce to market, which those who reside only one hundred miles from market now enjoy, provided the canal were toll free."

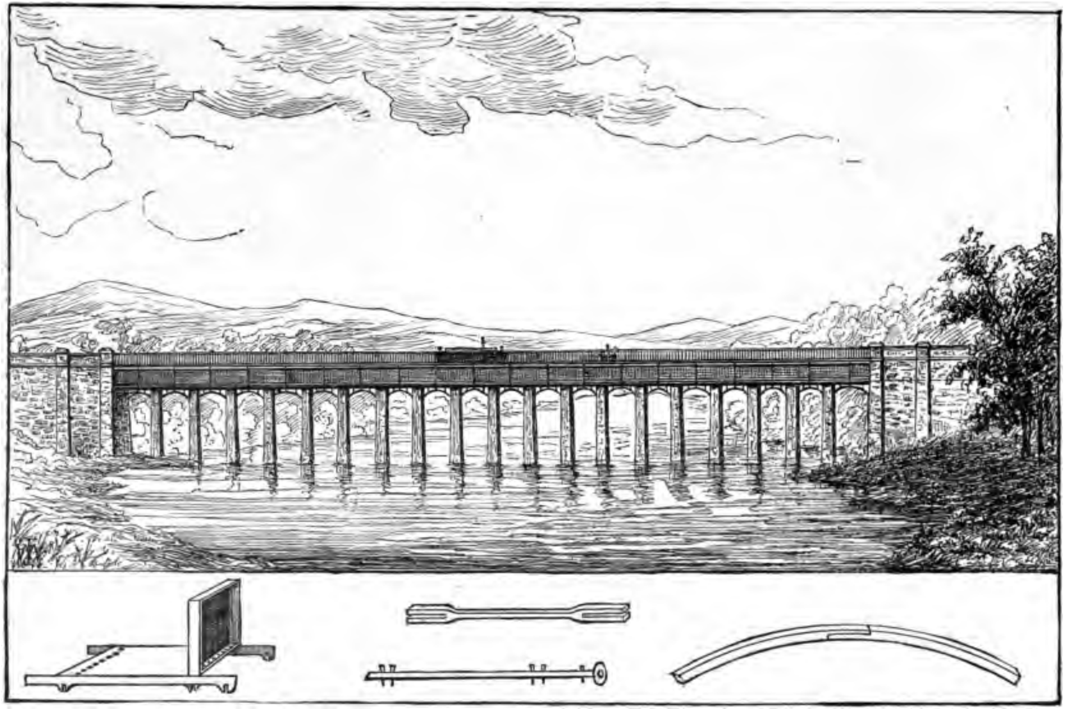
Fulton advocated the construction of the Erie Canal, either as a private enterprise by a company of stockholders, to whom he thought it would make a handsome return for their investment, or as a public enterprise to be paid for by the State. In the latter case he favored a system of tolls sufficiently large to pay the cost of the canal and also make a surplus which should be expended "in other canals, bridges, roads, and improvements." He made a careful computation of the revenue that might be derived from the canal, and thought it should pay for itself in five years from its completion.

He estimated the cost at $10,000,000. The canal was begun in 1817 and finished in 1825, and the total cost was $6,700,000. It is not often that the estimate of the engineer falls below the actual cost, or even remains within it, as many a capitalist knows to his sorrow.

As originally constructed the canal was forty feet wide at the surface and twenty-eight feet at bottom, with a depth of four feet. It has since been enlarged to seventy feet at surface and fifty-six at bottom, with a depth of seven feet. In their report of 1811 the commissioners advocated an inclined plane from Lake Erie to a reservoir near the Hudson, with a descent of six inches to the mile for three hundred miles, by making mounds and aqueducts over the valleys along the route. From the reservoir to the Hudson they proposed to have a series of locks, so that all the lockage on the route would be in a single place. After Mr. Fulton joined the commission this project was abandoned, probably through his advice, though this is not positively known.

Where the Shrewsbury Canal at Long, England, passes over the Tern valley upon an aqueduct nearly two hundred feet in length, serious damage was caused by a flood in the spring of 1795. Mr. Fulton was at Long at the time of the calamity, and after studying the canal and the conditions of its construction, he prepared drawings and plans for building canal aqueducts of cast-iron instead of stone. These were submitted to the British Board of Agriculture early in 1796, together with plans, drawings, and models of bridges.

His plans were approved and adopted. A cast-iron aqueduct upon the Fulton system was erected across the river Dee in Scotland, and one of his bridges was built at Wandsworth. The dimensions of the bridge are not given, but the aqueduct is thus described ;



Fulton's Cast-Iron Aqueduct, at Long, England.

"Nineteen massive conical pillars of stone, at fifty-two feet from each other, the middlemost of which is no less than one hundred and twenty-six feet in height, support between the top of every pair a number of elliptical cast-iron ribs, which, by means of upright and horizontal bars, support a cast-iron aqueduct about three hundred and twenty-nine yards long, twenty feet wide, and six in depth, composed of massive sheets of cast-iron, cemented and riveted together, having on its south side an iron platform and railing for the towing-path.

"It was foretold that the effects of heat and cold would destroy it, but no expansion and contraction of the metal is as yet visible; and notwithstanding the summer's heat, the winter's ice, and numerous floods, this cast-iron aqueduct still remains an evidence of Fulton's practical engineering."—*Reigart*, p. 95.

Other inventions, for some of which Robert Fulton obtained letters-patent in England, were as follows:

A mill for sawing marble. The British "Society for the Promotion of Arts and Commerce" passed a resolution of thanks to the inventor of this mill and awarded him an honorary medal.

A machine for spinning flax.

A dredging machine for scooping out the earth to form channels or aqueducts, which was afterwards much used in England.

A MARKET or PASSAGE boat, intended for canal navigation.

A DESPATCH boat, intended for similar uses, but of greater speed than the preceding.

A TRADER or amphibious boat, which was to be used on canals or rivers, and was capable of being moved for short distances on land. According to his plans it was twenty feet long, four wide, and two feet ten inches deep in the clear. It was flat at bottom and square at the ends, bolted and stayed at the corners, and had two ribs or knees about five feet from the ends. Two timbers running the length of the boat gave it strength to prevent breaking when on land; it was supported on wheels about ten inches in diameter, and two feet from the ends of the boat, and each pair of wheels and its axle were cast in one piece. The wheels were supported in brass sockets and fastened so as to remain in place when the boat was in the water. The wheels were not unlike those in use upon railway trucks in the feature of being fastened firmly to the axle or forming a part of it.

It is impossible to give a full account of Mr. Fulton's movements and occupations during the latter part of his stay in England. Just previous to his return to America he sent home a box containing many of his manuscripts and drawings; the vessel that brought it was wrecked, and though the box was afterwards recovered, many of the papers it contained were wholly illegible, while the few that could be deciphered were read with great difficulty. But from all that can be learned it is evident that from the time he became actively engaged in mechanical enterprises he gave little attention to painting; by far the greater number of the works of his brush, of which any trace can be found, belong to the early period of his life.

CHAPTER III.

Fulton in Paris—Joel Barlow—Experiments with torpedoes—Diving-boats—Proposals to the French Government—The reply—Official report of experiments—Holland and England—Blowing up the Dorothea.

IN 1797 Fulton went to Paris and took lodgings in the hotel occupied by Joel Barlow. A warm friendship sprang up between these gentlemen; Mr. Fulton resided for several years in Mr. Barlow's family, and the two seem to have been the closest of companions. They were associated in many projects and enterprises in which poesy, painting, and mechanics were indiscriminately mingled. Mr. Barlow dedicated his "Columbiad," a national and historical poem, to his "Friend, Robert Fulton," and the latter made a series of illustrations for the book, which was published at great expense. In December of 1797, Fulton and Barlow made an experiment on the Seine with a machine constructed by the former; its object was to impart motion to cases of gunpowder under water to certain designated points where they were to be exploded. They had high hopes concerning the invention, but were doomed to disappointment, as the machine failed to do what was expected of it

Joel Barlow was famous in his time as a poet and politician; he was born in Connecticut in 1755, and died near Cracow, Poland, in 1812. From 1788 till 1805 he resided abroad, most of the time in France, where the greater part of his literary work was performed. He is best known by his humorous poem, "Hasty Pudding," which was written at Chambery, while he was a member of a French commission to organize the newly acquired territory of Savoy. His more pretentious but less popular works were the "Vision of Columbus," "Conspiracy of Kings," and the "Columbiad" already mentioned. From 1805 till 1811 he lived at Washington, whence he was sent as Minister of the United States to France. He had a high reputation for diplomatic ability, and his death occurred while he was on a journey to meet the Emperor Napoleon at Wilna, by express invitation of the great soldier. On his deathbed he dictated a poem which assailed Napoleon for the course he had followed, in disappointing the hopes of men and spreading the horrors of war through Europe.*

While residing with Mr. Barlow, Fulton learned French, and acquired some knowledge of German and Italian; he also studied the high mathematics, chemistry, and other branches of science to which his attention had been directed in his mechanical

* See "Life and Letters of Joel Barlow," by Charles Burr Todd, published by G. P. Putnam's Sons, New York.

pursuits. His study of chemistry was no doubt brought about through his interest in torpedoes, to which he seems to have given a great deal of time. In spite of his occupation in these matters, he had sufficient leisure to paint a panorama, the first ever shown in Paris. Mr. Barlow was his partner in this enterprise, and it is said they made a snug sum of money by its exhibition.

Though disappointed with the experiment on the waters of the Seine with the machine mentioned, Mr. Fulton was not disheartened. With the perseverance which characterized him, he continued his studies and perfected his plans to his entire satisfaction. But boats cannot be built without money, and the inventor did not possess the necessary funds for the work he proposed. He addressed a letter to the French Directory, in which he set forth the usefulness of his invention in enabling the Republic to rid itself of oppressors, and when the letter was presented, it was received with words of encouragement. Day after day he went to the government offices to learn the decision upon his project, and finally was informed that the whole scheme was rejected by the Directory.

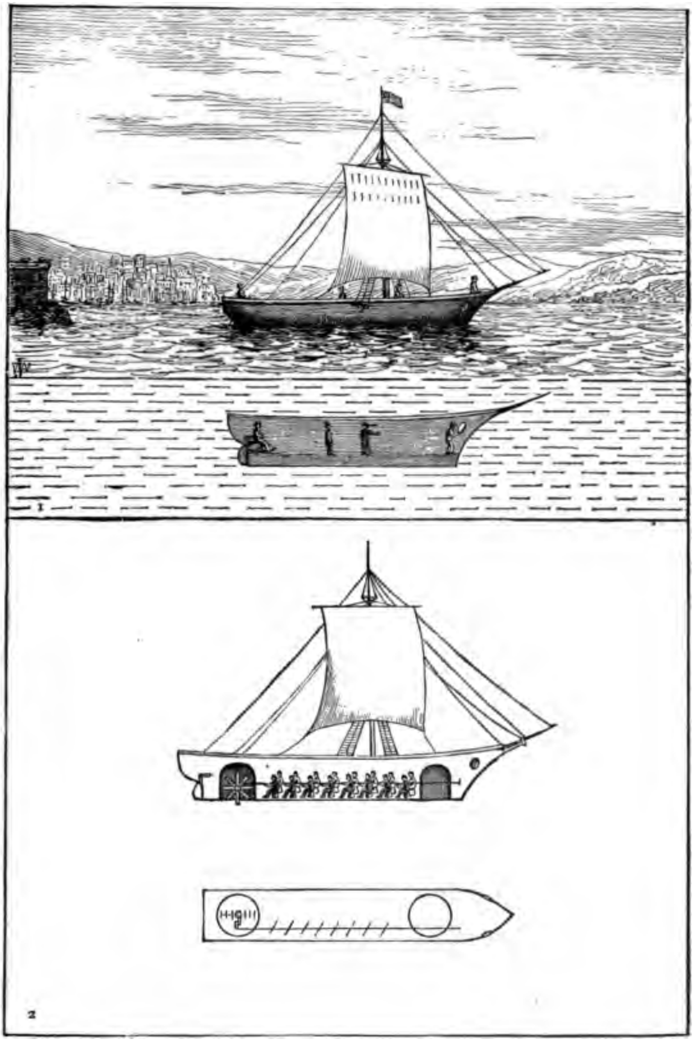
What followed is best told in the words of Mr. Colden:

"Mr. Fulton was never to be discouraged. He thought that the Directory might be induced to change their opinions, or that there might be, as there had been, a change in the executive. With these hopes he executed a handsome model of his machine, and a change having taken place as to one of the members of the Directory, he again presented his plan, and a commission was appointed to examine his pretensions. This commission made a very favorable report, but after another three months' attendance on the Minister of the Marine, Mr. Fulton was greatly disappointed to learn that his plan was entirely rejected.

"Not yet discouraged, he offered his project to the Dutch Government, through Mr. Schemelpenick, who was then at Paris as ambassador from Holland. A commissioner was in consequence appointed by the executive directory of the Batavian Republic, to examine his modles; but he met with another disappointment. The commissioners spoke so lukewarmly of his propositions, that the Dutch Government would not give him sufficient encouragement. An individual, however, of that nation, Mr. Vanstaphast, furnished him with the necessary funds, and he proceeded to construct his machine. When it was nearly complete, he again addressed the Dutch minister, who appears to have been personally friendly to his plan. Mr. Fulton pressed upon him the advantages which his nation might derive from adopting submarine navigation. Neither these letters, however, nor others, which he addressed at the same time to the Batavian Executive, appear to have had any success.

"But the French Government changed. Bonaparte placed himself at the head of it, with the title of First Consul.

"Mr. Fulton soon presented an address to him, soliciting him to patronize the project for submarine navigation, and praying him to appoint a commission, with sufficient funds and powers to give the necessary assistance. This



1. **Fulton's Submarine Boat, the Nautilus, in the Harbor of Brest,**
2. **Fulton's Submarine Boat, the Mute.**

request was immediately granted, and the citizens Volney, La Place, and Monge were named the commissioners.

"In the spring of 1801, Mr. Fulton repaired to Brest to make experiments with the plunging-boat he had constructed the preceding winter. This, as he says, had many imperfections natural to a first machine of such complicated combinations. Added to this, it had suffered much injury from rust, in consequence of his having been obliged to use iron instead of brass or copper for bolts and arbors.

"Notwithstanding these disadvantages, he engaged in a course of experiments with the machine, which required no less courage than energy and perseverance. Of his proceedings, he made a report to the committee appointed by the French Executive, from which report we learn the following interesting facts:

"On the 3d of July, 1801, he embarked with three companies on board his plunging-boat, in the harbor of Brest, and descended in it to the depth of five, ten, fifteen, and so to twenty-five feet, but he did not attempt to go lower, because he found that his imperfect machine would not bear the pressure of a greater depth. He remained below the surface one hour. During this time they were in utter darkness. Afterwards he descended with candles, but finding a great disadvantage from their consumption of vital air, he caused, previously to his next experiment, a small window of thick glass to be made near the bow of his boat, and he again descended with her on the 24th of July, 1801. He found that he received from this window, or rather aperture covered with glass, for it was no more than an inch and a half in diameter, sufficient light to enable him to count the minutes on his watch. Having satisfied himself that he could have sufficient light when under water; that he could do without a supply of fresh air for a considerable time; that he could descend to any depth, and rise to the surface with facility, his next object was to try her movements as well on the surface as beneath it. On the 26th of July, he weighed his anchor and hoisted his sails; his boat had one mast, a mainsail, and jib. There was only a light breeze, and therefore she did not move on the surface at more than the rate of two miles an hour; but it was found that she would tack and steer, and sail on a wind or before it, as well as any common sailing-boat. He then struck her masts and sails, to do which, and perfectly prepare the boat for plunging, required about two minutes. Having plunged to a certain depth, he placed two men at the engine, which was intended to give her progressive motion, and one at the helm, while he, with a barometer before him, governed the machine, which kept her balanced between the upper and lower waters. He found that with the exertion of one hand only, he could keep her at any depth he pleased. The propelling engine was then put in motion, and he found, upon coming to the surface, that he had, in about seven minutes, made a progress of four hundred metres, or about five hundred yards. He then again plunged, turned her round while under water, and returned to near the place he began to move from. He repeated his experiment several days successively, until he became familiar with the operation of the machinery and the movements of the boat. He found that she was as obedient to her helm under water as any boat could be on the surface, and that the magnetic needle traversed as well in the one situation as the other.

"On the seventh of August, Mr. Fulton again descended with a store of atmospheric air compressed into a copper globe of a cubic foot capacity, into which two hundred atmospheres were forced. Thus prepared he descended with three companions to the depth of about five feet. At the expiration of an hour and forty minutes, he began to take small supplies of pure air from his reservoir, and did so as he found occasion, for four hours and twenty minutes. At the expiration of this time he came to the surface, without having experienced any inconvenience from having been so long under water.

"Mr. Fulton was highly satisfied with the success of these experiments; it determined him to attempt to try the effects of these inventions on the English ships, which were then blockading the coast of France, and were daily near the harbor of Brest.

"His boat at this time he called the submarine boat, or the plunging-boat; he afterwards gave it the name of the Nautilus. Connected with this machine were what he then called submarine bombs, to which he has since given the name of torpedoes. This invention preceded the Nautilus. It was, indeed, his desire of discovering the means of applying his torpedoes that turned his thoughts to a submarine boat. Satisfied with the performance of his boat, his next object was to make some experiments with the torpedoes. A small shallop was anchored in the roads with a bomb containing about twenty pounds of powder; he approached to within about two hundred yards of the anchored vessel, struck her with the torpedo, and blew her into atoms. A column of water and fragments was blown from eighty to one hundred feet in the air. This experiment was made in the presence of the prefect of the department, Admiral Villaret, and a multitude of spectators."

Mr. Fulton planned another and larger boat for submarine purposes, but it was never constructed, owing to the lack of funds and the unwillingness of the French Government to appropriate the amount needed. Some of the French officers were enthusiastic over his plans. One of them, St. Aubin, wrote as follows concerning the proposed craft:

"The diving-boat will be capacious enough to contain eight men and provision for twenty days, and will be of sufficient strength and power to enable him to plunge one hundred feet under water, if necessary. He has contrived a reservoir of air, which will enable eight men to remain under water eight hours. When the boat is above water, it has two sails, and looks just like a common boat; when it is to dive, the mast and sails are struck.

"In making his experiments, Mr. Fulton not only remained a whole hour under water, with three of his companions, but had the boat parallel to the horizon at any given distance. He proved that the compass points as correctly under water as on the surface, and that, while under water, the boat made way at the rate of half a league an hour, by means contrived for that purpose.

"It is not twenty years since all Europe was astonished at the first ascension of men in balloons: perhaps, in a few years, they will not be less surprised to see a flotilla of diving-boats, which, on a given signal, shall, to avoid the pursuit of an enemy, plunge under water, and rise again several leagues from the place where they descended!

"But if we have not succeeded in steering the balloon, and even were it impossible to attain that object the case is different with the diving-boat, which can be conducted under water in the same manner as upon the surface. It has the advantage of sailing like the common boat, and also of diving when it is pursued. With these qualities, it is fit for carrying secret orders, to succor a blockaded fort, and to examine the force and position of an enemy in their harbors. These are sure and evident benefits which the diving-boat at present promises. But who can see all the consequences of this discovery, or the improvements of which it is susceptible? Mr. Fulton has already added to his boat a machine by means of which he blew up a large boat in the port of Brest; and if, by future experiments, the same effect could be produced in frigates or ships of the line, what will become of maritime wars, and where will sailors be found to man ships of war, when it is a physical certainty that they may at any moment be blown into air by means of diving-boats, against which no human foresight can guard them?"

The diving-boat was really an adjunct of the torpedo, as its principal object was to furnish a means whereby submarine explosions could be managed for the destruction of an enemy's ships. This system of warfare had its beginning in 1585 at Antwerp, when powder-vessels were set afloat on the Scheldt, with the object of destroying the ships of the besiegers. For nearly two hundred years after that time very little seems to have been done in the way of experiment in this direction. During the American Revolution, David Bushnell, a native of Connecticut and a captain of engineers, conceived the idea of a submarine boat which should be used to place a case containing one hundred and fifty pounds of gunpowder beneath a ship and explode it by means of clockwork. His models worked to satisfaction, but such was not the result with the actual machine.

The boat was constructed under Bushnell's supervision, and the case, with its powder and clock-work, was made ready. Bushnell wished to direct the affair in person, but General Washington would not consent to risk the life of the captain on an expedition that was perilous in the extreme. Sergeant Ezra Lee, also a native of Connecticut, volunteered for the enterprise, and on a dark night in August, 1776, the attempt was made to blow up the British ship Eagle, then lying in New York harbor and carrying the flag of Lord Howe. The plan was to attach the case of powder to the bottom of the Eagle by means of a screw, and when it was properly attached the clock-work was to be set in motion. It was made to run half an hour before exploding, and this half hour would be ample to enable the operator to get to a safe distance.

Lee had no difficulty in getting where he wished to go—beneath the bottom of the ship. But he found the copper sheathing of the Eagle was so thick that he could not attach the screw, and after working at the job for two hours he gave it up in despair. Then he tried other vessels with a like result, and, as morning approached, he came to the surface not far from some barges belonging to the British forces. Then he descended again, started the clock-work, and pulled to the shore, where he was received and congratulated by General Washington for his bravery. The powder exploded close to the flag-ship, and threw a great column of water far into the air.

The Eagle and other vessels of the British fleet cut their cables and drifted with the tide towards Staten Island. None of them were injured, but the attempt of the Yankees made their officers exceedingly cautious during the rest of the war. For the remainder of their stay in New York they were very prudent in their movements and chary about their anchorage.

Fulton was probably well acquainted with the exploit of Bushnell, as he seems to have started with his own experiments at the point where his predecessor stopped. He was the first to apply the name "torpedo" to this particular instrument of warfare, and since his time the name has adhered to it.

It is a curious circumstance that Fulton was a believer in universal peace, and he seems to have been animated by a desire to see the day when armies and navies would be no more needed. To this end he proposed to invent the means of destroying ships of war so that navies would be no longer possible, and by so doing he hoped to secure the free navigation of the ocean for all nations of the globe. In 1810 he published a book entitled "Torpedo War." It bore on its title-page the motto "The liberty of the seas will be the happiness of the earth." In his arguments before the officials of France, England, and the United States he invariably pressed his point that the seas would be made free by the adoption of his invention.

The English Government heard of the experiments which Fulton was making in France with his diving-boat and torpedoes, and there was great uneasiness in consequence. The British ministry held several consultations on the subject and determined to induce this dangerous inventor to leave France and take up his residence in England. Lord Sidmouth communicated with Fulton in Paris, and arranged for him to meet a British Government agent at Amsterdam. Accordingly Mr. Fulton went to the Dutch capital in October, 1803, and after waiting vainly three months for the British agent, returned to Paris. While in Holland he occupied his time in making improvments in his plans, and sketching the Hollanders and their quaint costumes. Many of his sketches are in the nature of caricatures, and show that he was not lacking in humor.

The agent who had failed to meet him in Amsterdam came to Paris, bringing a letter from Lord Hawkesbury to Mr. Fulton, in which the invitation to visit London was made in the most flattering terms. Fulton reached the British capital in May, 1804, and found that Lord Sidmouth had retired from office and the ministry was in the hands of Mr. Pitt. Though the new ministry was not particularly friendly with the old, it approved all that had been done in negotiation with Mr. Fulton, and it was not long before he was called to a personal audience with Mr. Pitt and Lord Melville. Fulton displayed his drawings and explained their meaning, and the ministers listened very attentively. When he was through, Mr. Pitt remarked that "if the torpedo was introduced into practice it could not fail to annihilate all military marines."

Pitt and other statesmen were disposed to encourage the invention, which would give England the supremacy of the seas if she could keep the invention in her own hands, but this view was not shared by all. The Lord High Admiral denounced Mr. Pitt for "encouraging a mode of warfare which those who commanded the seas did not want, and which, if successful, would wrest the trident from those who then claimed to bear it as the sceptre of supremacy on the ocean."

The British ministry appointed a commission to examine the invention and report. The commissioners were Sir Joseph Banks, Mr. Cavendish, Sir Home Popham, Major Congreve, and Mr. John Rennie. They took plenty of time for their deliberations, and finally reported that the submarine boat was impracticable.

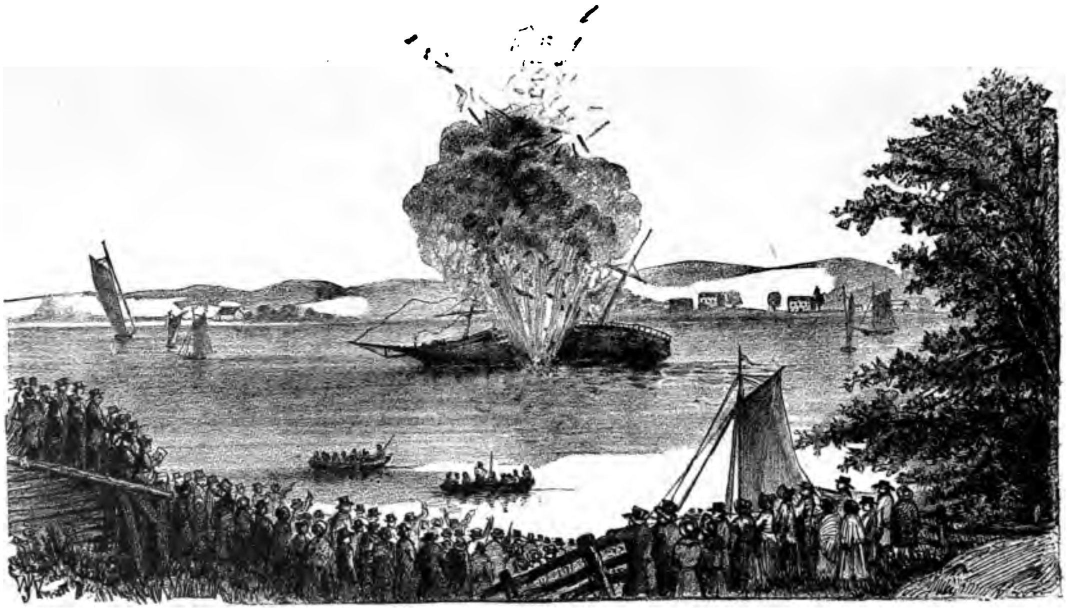
The torpedo without the submarine boat was worthy of consideration, and Mr. Fulton was authorized to blow up the French fleet in Boulogne harbor. He made the attempt, but the torpedoes exploded harmlessly at the side of the French vessels. The inventor was able to explain, as are most inventors under similar circumstances, why the experiment did not succeed. But the incident could not fail to damage his prospects materially.

In October, 1805, he blew up the Danish brig Dorothea, a vessel of two hundred tons, that had been provided by the British Government for the experiment. It was anchored in Walmar Roads, near Deal, and not far from Walmar Castle, the residence of Mr. Pitt. The Prime Minister and a large number of naval officers were present, and the affair, in theatrical parlance, was a complete success.

The Dorothea was anchored in a tide-way. She drew twelve feet of water, and the current flowing beneath her was quite strong. Fulton prepared two cylindrical cases connected by a line eighty feet long. One of the cases contained sand and the other was filled with one hundred and seventy pounds of powder, which was to be exploded by clock-work similar to that of Bushnell's torpedo, already described. The cases were thrown simultaneously from two boats seventy-five feet apart in such a way that they drifted across the hawser by which the Dorothea was anchored. When the line struck the hawser, the torpedoes, which had been balanced to float at a depth of fifteen feet, were swung around and carried by the tide directly beneath the ship. The explosion occurred exactly as Fulton had planned. In a letter to Lord Castlereagh, dated October 16, 1805, the inventor gives the following account of the affair:

"Yesterday about four o'clock I made the intended experiment on the brig with a carcass of one hundred and seventy pounds of powder, and I have the pleasure to inform you that it succeeded beyond my most sanguine expectations. Exactly in fifteen minutes from the time of drawing the peg and throwing the carcass in the water the explosion took place. It lifted the brig almost bodily and broke her completely in two. The ends sank immediately, and in one minute nothing was to be seen of her but floating fragments. Her mainmast and pumps were thrown into the sea, her foremast was broken in three pieces, her beams and knees were thrown from her deck and sides, and her deck-planks were rent in fibres. In fact, her annihilation was complete, and the effect was most extraordinary. The power, as I had calculated, passed in a right line through her body—that being the line of least resistance—and carried all before it. At the time of her going up, she did not appear to make more resistance than a bag of feathers, and went to pieces like a shattered egg-shell."

The ministry was a long while in deciding upon Fulton's invention, and the inventor waited somewhat impatiently for the result. It was finally determined that it would be impolitic for the greatest maritime power in the world to introduce into naval warfare a system that would place her on a level with weaker nations, and, consequently, the proposals of



Fulton Blowing up the Dorothea.

Fulton were declined. A commission suggested that he should receive an ample reward for his trouble and expense, on condition that his torpedo system should be suppressed, and neither England nor any other country be allowed to adopt it. In reply, Mr. Fulton declared that he could not accept the proposal on any terms. His answer contained the following paragraph:

"At all events, whatever may be your award, I never will consent to let these inventions lie dormant should my country at any time have need of them. Were you to grant me the annuity of twenty thousand pounds a year, I would sacrifice all to the safety and independence of my country."

A letter to Lord Granville on the same subject concluded with these emphatic words:

"It never has been my intention to hide these inventions from the world, on any consideration. On the contrary, it has ever been my intention to make them public as soon as may be consistent with strict justice to all with whom I am concerned. For myself, I have ever considered the interest of America, free commerce, the interest of mankind, the magnitude of the object in view, and the rational reputation connected with it, superior to all calculations of a pecuniary nature."

In September, 1806, Fulton wrote as follows to Mr. Barlow, who was then in America, supervising the publication of the "Columbiad."

"My arbitration is finished, and I have been allowed the £10,000 which I had received, with £5,000 salary,

Modern War Steamer Attacked by a Torpedo Boat.

total £15,000, though £1,600 which I have received on settling accounts will just square all old debts and expenses in London, and leave me about £200. My situation now is, my hands are free to burn, sink, and destroy whom I please, and I shall now seriously set about giving liberty to the seas by publishing my system of attack. I have, or will have, when Mr. Parker sends my two thousand pounds, 500 sterling a year, with a steam-engine and pictures worth two thousand pounds. Therefore I am not in a state to be pitied. I am now busy winding up every thing, and will leave London about the 23d inst. for Falmouth, from whence I shall sail in the packet the first week in October, and be with you, I hope, in November, perhaps about the 14th, my birthday, so you must have a roast goose ready. Do not write me again after receiving this. The packet, being well manned and provided, will be more commodious and safe for an autumn passage, and I think there will be little or no risk; at least, I prefer taking all the risk there is to idling here a winter. But although there is not much risk, yet accidents may happen, and that the produce of my studies and experience may not be lost to my country, I have made out a complete set of drawings and descriptions of my whole system of submarine attack, and another set of drawings with description of the steamboat. These, with my will, I shall put in a tin cylinder, sealed, and leave them in the care of General Lyman, not to be opened unless I am lost. Should such an event happen, I have left you the means to publish these works, with engravings, in a handsome manner, and to which you will add your own ideas—showing how the liberty of the seas may be gained by such means, and with such liberty, the immense advantages to America and civilization; you will also show the necessity of perfecting and establishing the steamboat and canals on the inclined-plane principle. I have sent you three hundred complete sets of prints for the 'Columbiad' by the Orb, directed to Mr. Tolman, New York, value £30. As the transport by land to Philadelphia will not be much, I have sent them by this opportunity, that they may arrive before the law for prohibiting such things is in force, and that the shipment and risk may not approach too near to winter. All my pictures, prints, and other things, I mean to leave here, to be shipped in spring vessels, about April next, when the risk will be inconsiderable. How shall we manage this winter, as you must be in Philadelphia for the printing, and I want to be at New York to build my boat? I am in excellent health, never better, and good spirits. You know I cannot exist without a project or projects, and I have two or three of the first order of sublimity. As all your prints are soldered up I do not see how I can leave the number you desire with Phillips (the English publisher), but as I leave the plates with Mr. West the necessary number can be struck off when the sheets arrive. We will talk of this in America. Mr. West has been retouching my pictures: they are charming."

CHAPTER IV.

Fulton returns to America—Plans for torpedo warfare—An amusing incident at a lecture—Blowing up a brig at anchor—Attack upon the sloop-of-war, Argus—Submarine guns and their execution—Development of torpedo warfare from Fulton's time to the present.

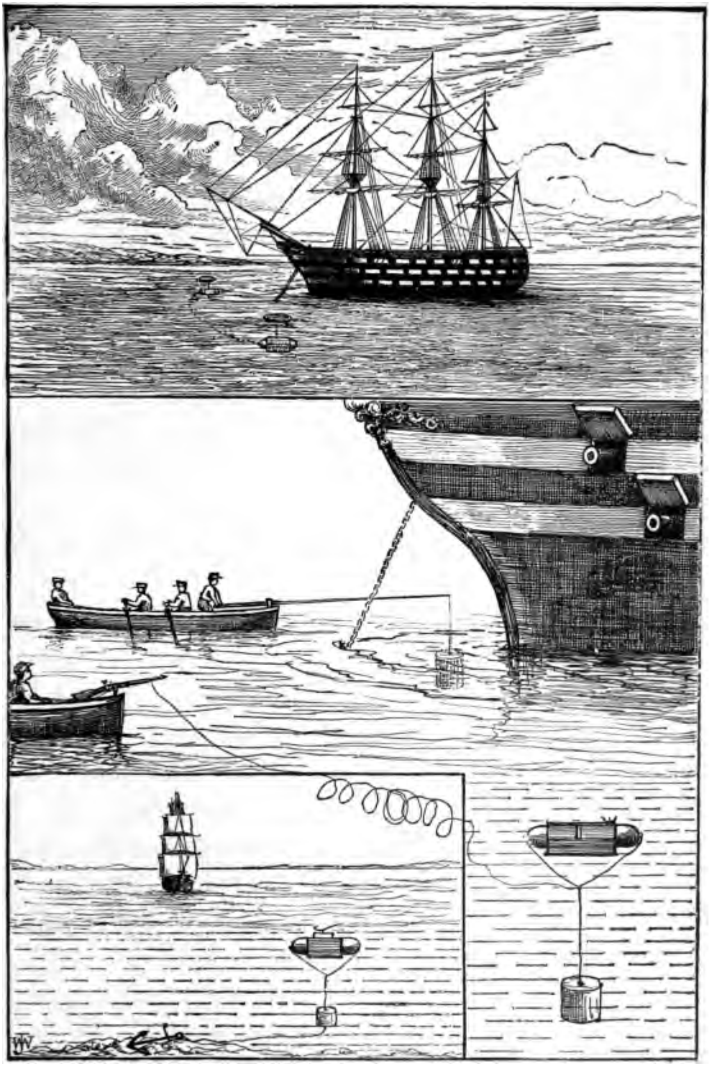
IN October, 1806, Fulton embarked at Falmouth by way of Halifax for New York, where he arrived on the 13th of December. He soon after went to Washington and laid his plans for torpedo warfare before the administration; they were favorably received, and a small appropriation was made to enable him to try experiments with his novel machines. He returned to New York, and while preparing his materials he announced a lecture upon torpedoes, to which the Mayor and many prominent citizens were invited. His audience was deeply interested as he exhibited the copper cylinders which were to contain the powder, and the clockwork to cause the explosions. At length he turned to a case to which one of the locks was attached, and drawing out a peg said: "Gentlemen, this is a charged torpedo with which, precisely in its present state, I intend to blow up a vessel. It contains one hundred and seventy pounds of powder, and if I were to allow the clockwork to run fifteen minutes, it would blow us all to atoms."

His audience drew back very quickly, and within five minutes Fulton was standing alone. He calmly replaced the peg and stopped the clockwork, but he could not reassemble his auditors until they were assured that the dangerous case had been returned to the magazine, and even then some of them declined to listen further. It is not surprising that they acted as they did, and the coolness of the inventor under the circumstances is an indication of his confidence that every thing was under perfect control.

On the 20th of July, 1807, he made the first of the experiments authorized by the United States Government and blew up the hulk of a brig that had been given to him for that purpose. The machinery failed to operate to his satisfaction, and the explosion did not take place until after repeated efforts, and some hours later than the time appointed for it. A large crowd had assembled to witness the explosion, and when it did come off, the greater part of the spectators had retired disappointed. The failure was due to the following circumstance which Fulton explained in his book upon torpedo warfare :

He had tried his torpedoes in a tub of water till they were properly balanced for floating in the desired position, but he had done this without the locks, which were by no means light. When the locks were attached, and the torpedoes were thrown into the water preparatory to floating against the hulk, the additional weight caused them to turn over. The consequence was that when the hammer of the lock drove up the pan the priming powder fell out, and the spark from the flint failed to perform its work. Percussion locks had not then been invented, and were practically unknown for more than a quarter of a century afterwards. Of course it was necessary to readjust the machines, and the readjustment required considerable time.

Fulton's experiments with torpedoes were continued at different times for several years, but their success was not sufficient to induce the government to make large expenditures for the adoption of the system. His plans included four kinds of torpedoes, of which one may be considered defensive and three offensive. The defensive torpedo was intended for anchoring in a harbor or river in such a position that an enemy's vessel striking against it would cause an explosion. The offensive torpedoes were drifting machines like that used in the destruction of the Dorothea ; harpoon-torpedoes which were to be attached to harpoons and thrown from small cannon, so that they would attach themselves to the enemy's vessels where they would be exploded by clockwork ; and spar torpedoes, attached to spars carried by vessels of peculiar construction, and projected against the ships doomed to be destroyed.



Fulton's Torpedo System,

The government authorities arranged for a trial of the offensive torpedoes upon the sloop-of-war Argus, under command of Captain Lawrence. Mr. Fulton explained to that officer his mode of attack, and the Argus was at once put in trim to make proper defence. A strong netting was attached to the sprit-sail yard and anchored at the bottom, and the ship was enclosed in a pen made by lashing spars together. No boat could reach the side of the ship without entering this pen, and the defenders were provided with grappling irons with which to seize and detain an assailing craft. They had pieces of iron suspended from the rigging and ready to be dropped into any boat coming beneath them, and they had scythes fastened to the ends of poles by which the heads of a boat's crew could be cut off. Then there were muskets, and the other small-arms of the day, and altogether it was evident that Fulton and his eight oarsmen would fare badly in case of real warfare of this sort. He acknowledged his inability to make any impression upon the Argus under such circumstances, but contended that an invention which compelled every hostile vessel entering our ports to make such elaborate preparations for defence could not fail to be of great importance. In this view several of the gentlemen who had been appointed to witness the experiment heartily concurred.

No attack was made upon the Argus at the time appointed beyond an attempt to use the harpoon-torpedo and a trial of a new invention which Mr. Fulton called a cable-cutter. The harpoon-torpedo was fired from a small canon, but it was found to be of less range than had been expected, and besides it did not attach itself to the side of the vessel as its inventor had hoped. The cable-cutter was a floating torpedo intended to attach itself to the cable of an anchored vessel and cut it by means of an explosion. Anchor chains, such as we have at the present day, were not then in use, the hempen cable being almost universally employed for anchoring ships of whatever tonnage. After repeated experiments, Fulton succeeded in cutting off a cable fourteen inches in diameter under water, but the assailants were so much exposed during the performance that it was deemed of no use in actual warfare. The commission did not report favorably upon it, and the Government declined to adopt the apparatus.

The result of these experiments gave Fulton the idea of firing guns under water, and he made elaborate calculations to ascertain the resistance of a ball of given dimensions with a given initial velocity. As the basis of his calculations he assumed that a body passing through water would meet the same resistance as the force required for a column of water of the same diameter moving with the same velocity. Then following the rules of hydraulics, he prepared his estimates, and found by actual experiment he was not far out of the way.

He tried a four-pound cannon having the breech and half its length enclosed in a water-tight box, from which the muzzle, carefully stopped with a tompion, projected. The box was then placed in the water so that the cannon was three feet below the surface, and the gun was fired by dropping a coal of fire into a tin tube that terminated at the vent. The ball struck the sand at the bottom of the river forty-one feet from the muzzle, and the gun was not injured in the least. He next tried the same cannon charged with a pound and a half of powder and fired by one of his water-tight locks at a distance of three feet below the surface. The ball penetrated to a depth of eleven and a half inches in a wooden target twelve feet from the muzzle, and, as in the previous instance, the gun suffered no damage.

At his next experiment he fired a one-hundred-pound ball from a columbiad at the same target, which was quite knocked to pieces, while the gun escaped injury.

In 1813 he took out a patent "for several improvements in the art of maritime warfare, and means of injuring and destroying ships and vessels of war by igniting gunpowder under water, or by igniting gunpowder below a line horizontal to the surface of the water, or so igniting gunpowder that the explosion which causes injury to the vessel attacked shall be under water." His plan was to place guns in a ship below her water-line, with the breech on the inside of the ship and the muzzle under water, and he claimed there would be no more danger that the guns would burst than when fired in the air. He proposed that the muzzle of the gun should recoil through a stuffing-box, and that a valve should instantly close the orifice after the discharge, so that water could not be admitted.

Fulton's idea of submarine guns does not seem to have been favorably received by the government, or, at any rate, it was not adopted. Within the last few years Mr. John Ericsson, the celebrated inventor, has developed a plan for a boat with submarine guns. He is confident that the "Destroyer," as he calls his craft, will create a new era in naval warfare as soon as the principle is adopted.

Before dismissing the machines which destroyed the Dorothea but failed to injure the Argus, a few words upon the progress of torpedo warfare will not be without interest.

Just before the close of the war of 1812–15 the government decided upon a general system of defensive torpedoes for the principal Atlantic ports, but the measure was dropped upon the declaration of peace, as the country could not afford the needed expenditure. During the war several private attempts were made to inflict damage upon British ships on our coast, and though none of the hostile craft were seriously harmed, the dread of the terrible torpedoes kept the enemy at a distance and saved many of our ports from invasion. Boats on the Bushnell system were sent against the blockading squadron near London, but they did not succeed, and an immense torpedo sent against the man-of-war Plantagenet, seventy-four guns, off Cape Henry, Virginia, exploded a few minutes too soon. It flooded the Plantagenet's deck with water, and nearly upset the vessel, but she righted herself and escaped injury.

From that time until the Crimean war little was heard of torpedoes; attention was then drawn to them by their use in the waters of the Baltic and Black seas where several explosions occurred beneath British ships but without serious results. In the American civil war torpedoes were freely used in defending the Southern ports, and several ships (some fifteen in all) were destroyed by them; in a few instances, notably that of the destruction of the ram Albemarle at Plymouth, N. C., the torpedo performed effective offensive work. The principal destruction caused by torpedoes was in the last two years of the war. In writing of these weapons a gallant naval officer, Captain Chandler, used the following words:

"The torpedo is destined to be the least expensive but most terrible engine of defence yet invented. No vessel can be so constructed as to resist its power; and the uncertainty of its locality would prevent the hostile fleet from approaching the supposed positions. In all collisions between hostile powers, whether army against army, ship against ship, or ship against fort, more or less bravery has been and is destined to be displayed; but the uncertainty of the locality of the foe—the knowledge that a single touch will lay our ship a helpless, sinking wreck upon the water, without even the satisfaction of firing one shot in return—calls for more courage than can be expressed, and a short cruise among torpedoes will sober the most intrepid disposition."

Beginning about 1830 Colonel Samuel Colt, the inventor of the revolving pistol which bears his name, experimented with electricity in discharging torpedoes. He blew up several ships at anchor during experiments covering nearly fourteen years; on April 13, 1843, he destroyed a brig under full sail in the Potomac River, by means of a torpedo fired from a battery at Alexandria, five miles away. He devised a system of torpedoes which should be planted at different points in a harbor and connected with the shore by means of insulated wires. Reflectors would show when a hostile ship was above one of these torpedoes, and the operator at his station could blow her into fragments simply by depressing a key. After his death the details of this project were found among his papers, bearing the date 1836. Captain Hennebert, a French engineer officer, prepared an elaborate system of submarine mines soon after Colonel Colt's experiments, but it does not seem to have been adopted by his government, though it was favorably received by military men.

During the past twenty years all the principal nations have given much attention to torpedoes both for offence and defence, and large amounts of money have been expended on experiments and in the construction of torpedo boats. Space will not permit a detailed account of the progress that has been made in torpedo warfare since the days of Bushnell and Fulton, but it is proper to say at the outset that the plan on which much of their hope was based, that of submarine boats operated by men, has been very generally discarded. Submarine boats are used under several systems, but they are propelled by electricity, compressed air, or some other inanimate power that does not involve risk to the life of the operator. A few submarine boats which carry men in their interiors have been constructed, but at present none of them have been tried in actual warfare. Further reference to these boats will be made in a later chapter.

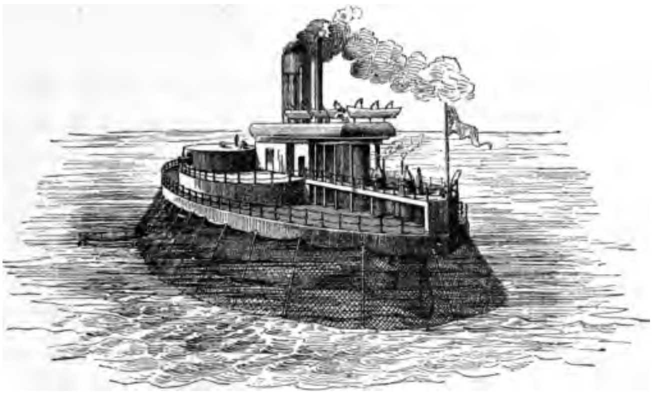
Offensive torpedoes are of two general kinds—those which are carried upon spars by swiftly-moving boats and those which are launched from boats or from the shore and move under the water or just upon its surface. The first are known as "spar" and the second as "fish" torpedoes, and there are several varieties of each kind. With the spar torpedo the assailant must approach very near the ship he wishes to destroy and thus be subjected to its fire. The ram Albemarle was destroyed by a spar torpedo, but the explosion came near causing the loss of the entire attacking party, consisting of Lieutenant Cushing and thirteen men. The torpedo boat was overturned, and only the lieutenant and one man escaped death or capture. Torpedo boats of this class were used in the late war between Russia and Turkey, and also in the difficulties between France and China. They were less successful in the former than in the latter instance.

The fish torpedo is designed to go beneath the surface of the water. It consists of a cylindrical boat pointed at the ends, carrying a torpedo in its bow, and having its propelling and steering apparatus at the stern. It is started from a ship or boat or from the shore, and is expected to explode its torpedo when it comes in contact with the ship against which it is directed. Those which are propelled by electricity carry a coil of insulated wire, which is reeled off as the boat proceeds. The operator can send positive or negative currents of electricity through the wire at pleasure, and can control the motion of the boat by means of these currents.

In one variety of fish torpedo the boat is a few feet below the surface of the water. Two guiderods extend above the surface and enable the operator to know the position and direction of the craft. He can make it move to the right or left, or can even require it to describe a circle and return to the starting-point. Another fish torpedo is propelled by compressed air supplied through a flexible tube, which is drawn after the boat as it proceeds. In this class of boat the power remains with the operator, and it is claimed to be a more simple device than the electric boat.

The great difficulty in the use of offensive torpedoes arises from the unwillingness of naval commanders to keep their vessels in the positions desired by their assailants. In a trial of a torpedo in a peaceful locality, a scow or hulk, anchored in a tide-way or floating with a current, may be blown up with ease, as the operator can calculate the force and direction required for reaching the object. But in actual warfare, the captain of a ship does not in his sober moments anchor within torpedo range of his enemy, or, if occasion requires him to do so, he surrounds his vessel with defences similar to those which foiled Mr. Fulton in his essay upon the Argus.

Every maritime nation manages to become acquainted with the assailing devices possessed by its enemy, and up to the present time no human skill has been able to construct an offensive torpedo which could not be successfully resisted or avoided by other human skill. In the last war between Russia and Turkey offensive torpedoes were largely used, but they succeeded in only two instances, and both of these were of minor consequence. Two Turkish gunboats on the Danube were blown up, but no sea-going vessels were destroyed, though the Russians made many attempts upon the Turkish fleet.



British Iron-clad Protected by Torpedo Netting.

But in defensive warfare the torpedo is playing an important part, and is destined to greater prominence as time goes on. Recent improvements in naval architecture have led to the construction of ships capable of passing the strongest fortifications with comparatively little risk, and demonstrated the necessity of other means of defence than batteries of artillery. In all the great nations a careful distinction is made between offensive and defensive torpedoes. In the United States the naval school for offensive torpedoes is at Newport, Rhode Island, while the defensive torpedo school is at Willett's Point, New York.

After the American civil war the first conspicuous use of torpedoes in defence was in the Schleswig-Holstein war, when the Danes protected their rivers and harbors with ingenious submarine mines which destroyed one of the attacking ship and caused the others to be very wary in their movements. In the South-American wars a few years later the rivers and harbors were protected by torpedoes, and the same was the case with the harbors of France and Germany in their war of 1870–71. In fact, nearly every nation that has had hostilities with another in the past twenty years has resorted to the torpedo as a most important means of defence.

In protecting a seaport with torpedoes the moddern system has rendered an attack by a fleet a matter of great risk to the invader. Mines may be planted all over a harbor and in its channels, so that a vessel cannot move in any direction without passing over some of them. They can be fired by electricity, either by contact with a buoy or by a current sent from the shore, and by means of reflectors and cameras the position of an enemy's ship may be shown to the operator safely lodged in a casemate of a fortress. He has only to depress a button at the proper moment to blow the ship into fragments. By throwing off the electric current the torpedoes may be rendered perfectly harmless to friendly ships, while a restoration of the current instantly puts the mine again in effective condition. Any attempt of an enemy to grapple the torpedoes and remove them at night, will be revealed by the electric current, and it may even be so arranged that the guns of a fort aimed at a given torpedo will be discharged automatically by electricity the moment the torpedo is disturbed. Light-draft torpedo boats are an important adjunct to the defence of a harbor, and nearly all the leading nations of the world are provided with them.

But while talking about torpedoes, we have not forgotten Fulton. When he left England in 1806, he had other objects in view besides warfare by means of explosives, as we shall learn in the next chapter.

CHAPTER V.

Fulton's experiments with steam navigation—Correspondence with the Earl of Stanhope—Attempts of inventors previous to Fulton's time—Chancellor Livingston—Association of Livingston and Fulton—Experiment on the Seine in 1803—Engine of the Clermont ordered.

THE date at which Fulton's attention was called to the propulsion of boats by steam is not exactly known, but his friends have claimed that it was as early as 1790. The first record concerning it is in his letter to the Earl of Stanhope, dated September 30, 1793, which was answered on the 7th of the following month in these words:

"SIR: I have received yours of the 30th of September, in which you propose to communicate to me the principles of an invention which you say you have discovered, respecting the moving of ships by means of steam. It is a subject on which I have made important discoveries. I shall be glad to receive the communication which you intend, as I have made the principles of mechanics my particular study." * * *

Fulton never claimed to have been the first to suggest steam navigation, but simply to have devised improvements by which it could be successfully accomplished. All previous attempts had failed to be remunerative to those who made them, and it is a matter of history that the first successful steamboat was the one built by the man whose biography is here written.

A summary of these attempts will be interesting at this point.

Spanish writers believe that one of their countrymen, Blasco de Gary, propelled a vessel by steam in the harbor of Barcelona in 1543, and they assert that the ship was moved at the rate of one league per hour. No details of the experiment are given, except that it was made at the order of the king, and the apparatus was applied to the "Trinity," a vessel of two hundred tons burthen.

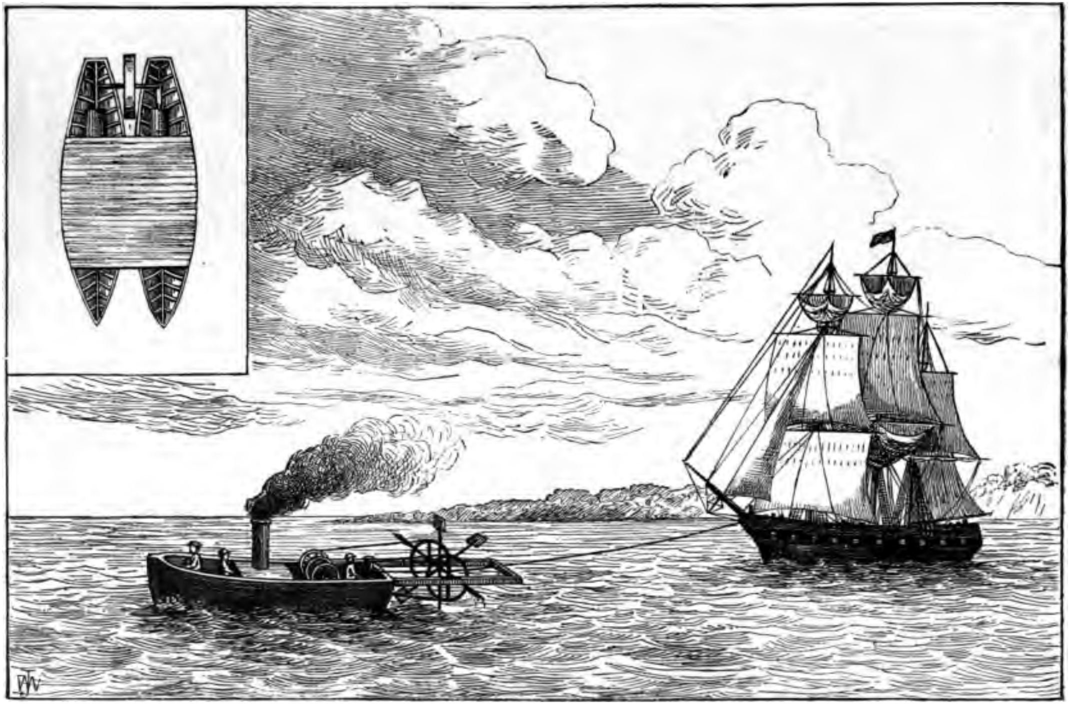
Nearly all writers upon steam navigation discredit the story concerning Blasco de Gary, and say the first authentic steamboat was that of Papin, who published a work in 1690, in which he proposed steam as a universal motive power, and gave a rude plan of a paddle steamer. In 1707 he made a model steamboat, and tried it upon the river Fulda near Cassel. Evidently it was not successful, as it does not seem to have been heard of afterwards. In 1736, Jonathan Hulls took out a patent for a marine engine, which he proposed to place in a boat which was to be used for towing ships very much as the modern tow-boat is employed. His boat was equipped with a single wheel at the stern, and the power was carried to it by bands passing over wheels.

William Henry, of Chester County, Pennsylvania, tried a model steamboat on the Conestoga in 1763, and it has been surmised that Fulton was familiar with this experiment. The Count d'Auxiron, M. Perier, and the Marquis de Jouffroy, made similar trials between the years 1774 and 1783.

The boat of the Marquis de Jouffroy was about forty feet long, and was propelled by paddles which were made to dip in the water while advancing through it, their return motion being performed in the air. The trial was made at Lyons in the presence of the entire population of the city and several officials of the government. The boat ascended the swift current of the river, and though the experiment was considered successful, the government refused to grant a patent to the inventor. French writers generally claim for the marquis the honor of having invented the steamboat, and this claim was supported by M. Arago and the French Academy long after the death of the individual most interested in the matter. It it also claimed that Fulton became acquainted with the marquis during his sojourn in France and obtained from him the ideas which he afterwards put in practice in America.

In connection with the French claim the following letter from Joel Barlow to Mr. Fulton is interesting:

"To-day I went to the National Depot of Machines with Parker to show it him, and there I met Montgolfier,



Jonathan Hull's Tow-Boat—1736.

and there I saw a strange thing; it was no less than your very steamboat, in all its parts and principles, in a very elegant model. It contains your wheel-oars precisely as you have placed them, except that it has four wheels on each side to guide round the endless chain instead of two.

"The two upper wheels seem to be only to support the chain; perhaps it is an improvement. The model of the steam-engine is in its place, with a wooden boiler, cylinder placed horizontal, every thing complete. I never saw a neater model. It belongs to a company at Lyons, who got out a patent about three months ago. Montgolfier says they have made their funds to the amount of two millions for building boats and navigating the Rhone. They have already spent six hundred thousand francs in establishing their *atelier* at Lyons. They have not yet tried the experiment *en grand.* I talked with M. a great deal about it, and told him it was Fulton's idea in every part except the cylinder being horizontal, which I believed would not do. He says none of it will do, and 'if M. Fulton had spoken to me of that, I would have complained to him of that defect; and if I had 30,000 francs in that enterprise at Lyons, I would have sold them for a thousand ecus.'

"I found, however, after a long discussion, that his objections arose entirely from what you are well aware of, and have calculated exactly, using water instead of land for the *point d'appuye.* He said nothing that would be new to you. He says that common oars and all modes of moving a thing in water by pushing against water lose ninety-nine hundredths of your power. You see he is not aware that it is a subject of accurate calculation, and that you may know exactly the difference between pushing against water and against solid bodies. I shall say nothing to Livingston of this model."

The next experiment was made in 1784 by James Rumsey, an American inventor, who built a boat which was propelled by a jet of water forced out at the stern by means of pumps worked by steam power. Rumsey made a trial of his boat on the Potomac River in September of that year in the presence of General Washington and other officers of the army. In 1786 and again in 1787 he repeated the experiments in larger boats than the first, and his invention was considered sufficiently practicable to recommend it to capitalists.

The "Rumsey Society" was formed in Philadelphia in 1788, and the inventor went to England where another boat was constructed; patents were obtained in England, France, and Holland, and a successful trip was made on the Thames in 1792. While making preparations for another trial Rumsey died suddenly and the company seems to have dissolved.

Previous to his departure from America Rumsey was in a bitter controversy with John Fitch of Philadelphia, in which a great many sharp things were said on both sides. Fitch had designed a steamboat about the beginning of 1785, and in the following year he exhibited the working model of a boat with a cylinder one inch in diameter. Exclusive privileges for steam navigation were granted him by the Legislature of Pennsylvania, and afterwards of New York and Delaware in March 1787;

in August of the same year he completed and tried a boat with a twelve-inch cylinder, but she proved deficient in speed. In 1788 a new boat was built for the same machinery, and it made several passages between Philadelphia and Burlington with a speed of about four miles an hour.

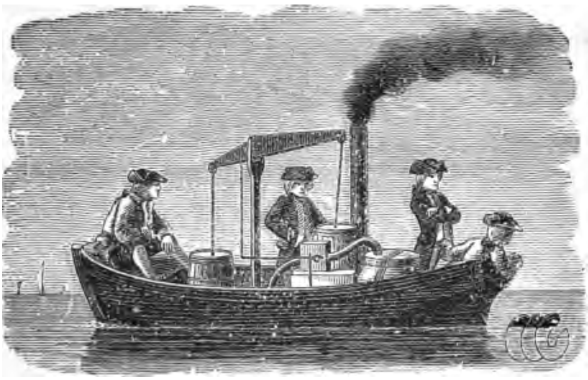
The last and largest boat upon Fitch's plan was built in 1789 and tried in 1790; it had a cylinder eighteen inches in diameter and was run as a passenger boat on the Delaware for the entire summer of that year. It made about seven and a half miles an hour and altogether is said to have run more than two thousand miles before it was finally laid up. As a speculation it was a failure and the stockholders refused to advance more money for the enterprise; Fitch was reduced to poverty and for some time wandered through the streets of Philadelphia hardly knowing where his next meal would be obtained. Through the aid of friends he was able to go to France in the hope of introducing his invention there, but the hope was blasted and he returned from Europe as a sailor before the mast.

Fitch constantly asserted that steamships would one day navigate the ocean and that the traffic on great rivers would be conducted exclusively on boats propelled by steam. He predicted that some one who came after him would obtain honor and fortune by establishing steam navigation on a

John Fitch's Steamboat at Philadelphia.

sound basis, and he was very bitter towards those who did not believe in his projects. He died suddenly in 1798 in the midst of discouragements, the last one being his inability to induce capitalists to undertake the formation of companies for the navigation of our western rivers by steamboats.

Fitch's boat was propelled by oars or paddles working at the sides of the craft in much the same



John Fitch, 1796. Collect Pond, New York.

way as the boat of the Marquis de Jouffroy. In 1796 he tried a small boat on the Collect Pond, New York, which has been described as a screw propeller, as it was driven by a submerged wheel. According to the description made at the trial, it was a ship's yawl fitted with a screw greatly resembling the one afterwards brought forward by Woodcraft.

Fitch seems to have fallen just short of success and it is probable that the science of steam navigation owes more to him than to any other of Fulton's predecessors. If the boat of 1790 had been commercially remunerative it would have led to the construction of other boats for the navigation of the Delaware; from Philadelphia the knowledge and application of Fitch's invention would have spread through the country, and from America to the rest of the world. But failure caused the total abandonment of the enterprise and we hear no more of steam navigation in America until near the beginning of the nineteenth century.

A model steamboat was constructed in 1789 by Nathan Read, who had previously experimented with a boat propelled by paddles attached to a crank worked by hand. With this boat he crossed with great ease an arm of the sea in Danvers, Massachusetts, and his success convinced him that the paddle-wheel was an effective mode of propulsion. He applied for a patent upon his system, but before his papers were considered he learned that the paddle-wheel had been rejected in France as impracticable. Supposing this previous experiment would invalidate his claim, he withdrew the part of his application referring to the wheels, and retained only the claim for a portable furnace and tubular boiler. He afterwards applied for a mode of propulsion by means of an endless chain with buckets or paddles attached, though he still preferred the wheel.

William Longstreet, a native of New Jersey, and in 1790 a resident of Georgia, wrote in that year a letter to Thomas Tolfairs, of Savannah, asking assistance in the construction of a boat to be propelled by steam. The letter was published in the Savannah papers, but did not bring the needed funds. Subsequently he obtained sufficient money to build a boat which was propelled on the Savannah River, against the tide, five miles an hour. The plan of propulsion is not known. The enterprise was unsuccessful, and Longstreet turned his attention to the construction of cotton-gins and other machinery, until his death, in 1814.

Elijah Ormsbee, a native of Connecticut, lived, in 1792, at Providence, Rhode Island. He was a carpenter by trade, and had the ingenuity for which the Yankee is proverbial. He proposed to David Wilkinson, of Pawtucket, that the latter should make certain castings for a steam-engine, while he (Ormsbee) would make the wood-work for an engine for propelling a boat. Wilkinson agreed to the proposal and made the castings and wrought-iron work suggested by Ormsbee. The latter borrowed a long-boat belonging to the ship Abigail, from her owners, Clark and Nightengale, and also borrowed a copper still of one hundred and fifty gallons' capacity from Captain Ephraim Bowen.

With the boat and materials he retired to a place called Windsor Cave, where he worked diligently to carry out his idea. He had discussed with Wilkinson the mode of propulsion. After much deliberation they decided that paddle-wheels would not answer, and gave their preference for a "goose-foot." This was a sort of paddle which was moved forward and aft by the engine; as it went forward it closed, but immediately opened on being pressed against the water. The action of the foot of the goose, or other aquatic bird, had given the idea of this mode of propulsion.

One afternoon in the autumn of 1792, Ormsbee was ready, and made an experimental trip from Windsor Cave to Long Wharf, Providence. The next day he went to Pawtucket to show Wilkinson the success of the scheme, and for several weeks the boat went up and down the river frequently, at the rate of between three and four miles an hour. But nobody would advance the necessary capital for the construction of a larger steamer, and, after several vain attempts to obtain it, Ormsbee returned the long-boat and copper still to their owners and went to work again at his bench.

Samuel Morey, of Connecticut, made experiments on the Connecticut River between 1790 and 1794, at propelling boats by steam. In the first named year he constructed a model steamboat, and in 1793 he built a boat with a wheel at the stern, which is said to have ascended the Connecticut

River between Oxford and Fairlee at the rate of five miles an hour. The boat was just large enough to contain himself and his machinery. In 1794 he is said to have built a larger boat, with which he went from Hartford to New York, where the craft was seen by Chancellor Livingston, Judge Livingston, Edward Livingston, John Stevens, and others.

Morey took out patents for the application of steam to the propulsion of boats previous to the patents of Fulton. His biographer, Rev. Cyrus Mann, of Oxford, New Hampshire, says Morey corresponded with Fulton, and showed him the model of his boat before the Clermont was begun. In 1797 Morey built a steamboat at Bordentown, New Jersey, and ran it to Philadelphia. It was propelled by wheels, one on each side, with a shaft running across the boat, and having a crank in the centre. Down to his death, in 1843, Morey claimed that Fulton stole the idea of the steamboat from him. This claim is weakened by the fact that Fulton was not in America at the time of Morey's experiments, and his plans for building the Clermont were made on the other side of the Atlantic after his experiments with Livingston in France.

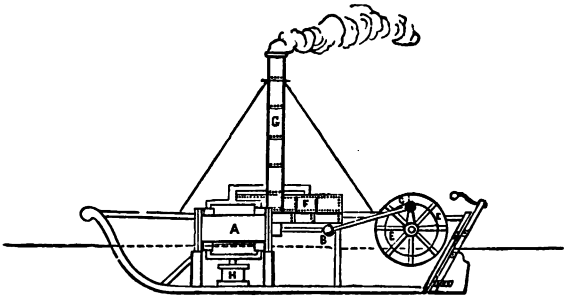
The Maryland Historical Society published in 1871 "A Lost Chapter in the History of the Steamboat," by J. H. B. Latrobe. In this pamphlet the claims of Nicholas J. Roosevelt as the inventor of the steamboat are set forth. Roosevelt in 1815 sent a petition to the Legislature of New Jersey, in which he claimed to be "the true and original inventor and discoverer of steamboats with vertical wheels." In an affidavit attached to his petition he says that in or about 1781 or 1782 he made a wooden model of a boat with vertical wheels which were propelled by springs of hickory or whalebone attached to a cord passing

Miller, Taylor, and Symington, 1788.

between the wheels. In 1798 he agreed with Chancellor Livingston and John Stevens to build a boat on joint account. The engines were to be constructed at Second River by Roosevelt, while the propelling power was to be on the plan of the Chancellor.

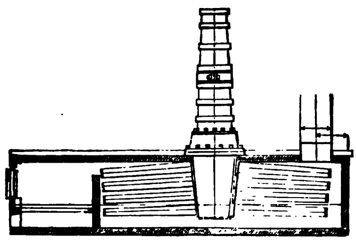
The propelling power was an endless chain with floats or paddles, and the boat was tried in the latter part of 1798. It attained a speed of three miles an hour with the wind and tide in its favor. Roosevelt proposed to the Chancellor to have vertical wheels over the sides of the boat, but the latter replied October 28, 1798: "As for the vertical wheels, they are out of the question." The experiments were continued through 1799 and 1800, but were brought to an end near the close of the latter year by the appointment of Chancellor Livingston as Minister to France.

While Fitch and Rumsey were making their experiments on the Potomac and Delaware, and indulging in that war of pamphlets which was injurious to the honor and fortunes of both, experiments were making on the other side of the Atlantic. In 1788 three Scotchmen—Miller, Taylor, and Symington—tried a boat on the Dalswinton River and obtained a speed of five miles an hour. Their boat consisted of two hulls with a wheel between them propelled by an engine in one of the hulls. Craft of similar construction may be seen to-day at St. Louis, where they are used as ferries. Another and larger boat was built by the same gentlemen in 1789 and attained a speed of seven miles an hour. In 1801 Lord Dundas engaged Symington to construct a boat for towing on the Caledonian Canal. It was completed and put in operation in 1802 under the name of the "Charlotte Dundas," and was capable of drawing a vessel of 140 tons nearly four miles an hour. It was found, however, that the "wash" caused by the wheels was very detrimental to the banks of the canal. The boat was laid up after a few years, and finally rotted to



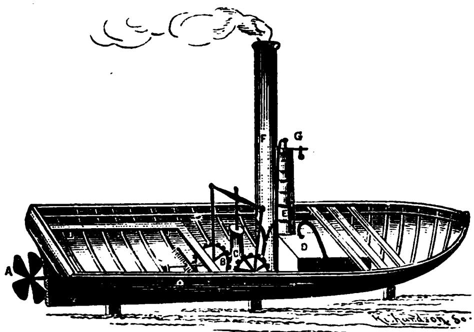
The "Charlotte Dundas," 1801.

pieces where she lay. English writers have claimed that Fulton obtained his ideas of a steamboat from the Charlotte Dundas, but it is pretty certain he never saw that vessel, and there is no proof that he ever heard of her.



Stevens' Sectional Boiler, 1804.

One more experimenter precedes Fulton—it is Colonel John Stevens, of Hoboken, who obtained a patent in 1804 for a sectional boiler, and built a steamboat with twin screws driven by a high-pressure engine attached to a boiler of the new design. His boat was sixty-eight feet long and fourteen feet broad, and the machinery is preserved in the Stevens Institute at Hoboken. It was placed in a new hull in 1844 and tried on the Hudson, where it attained a speed of eight miles an hour. It is a curious circumstance that the screw principle was applied to the propulsion of vessels before the paddle



Stevens' Screw Steamer, 1804.

steamer became successful; that it was neglected for about forty years and again assumed prominence. At present the paddle-wheel is almost wholly abandoned for the screw in ocean navigation, and is taking its place in many inland waters, where sufficient depth for the proper working of the screw can be obtained.

The celebrated Dr. Franklin proposed a steamboat which was to be moved by a column of water flowing out at the stern ; his plan was never tried by himself but the same idea had occurred to Rumsey, whose experiment failed as already mentioned. Dr. Franklin became convinced that it was not practicable and economical to move boats by steam owing to the great cost of running the engines and the large space they would occupy. The same belief was expressed by Benjamin H. Latrobe, an eminent engineer, in a paper read before the American Philosophical Society of Philadelphia, on the 20th of May 1803. At the conclusion of his paper Mr. Latrobe said :

"There are, indeed, general objections to the use of the steam-engine for impelling boats, from which no particular mode of application can be free. These are :

"First. The weight of the engine and of the fuel.

"Second. The large space it occupies.

"Third. The tendency of its action to rack the vessel and render it leaky.

"Fourth. The expense of maintenance.

"Fifth. The irregularity of its motion, and the motion of the water in the boiler and cistern, and of the fuel-vessel in rough water.

"Sixth. The difficulty arising from the liability of the paddles or oars to break, if light, and from the weight if made strong.

"Nor have I ever heard of an instance, verified by other testimony than that of the inventor, of a speedy and agreeable voyage having been performed in a steam-boat of any construction.

"I am well aware that there are still many very respectable and ingenious men, who consider the application of the steam-engine to the purpose of navigation, as highly important and very practicable, especially on the rapid waters of the Mississippi; and who would feel themselves almost offended at the expression of an opposite opinion. And perhaps some of the objections against it may be avoided. That founded on the expense and weight of the fuel, may not, for some years, exist on the Mississippi, where there is a redundance of wood on the banks; but the cutting and loading will be almost as great an evil."

In the light of the progress that has been made in steam navigation we may be inclined to smile at this gentleman's suggestions, but he echoed the general belief of the scientific men of the day, and his paper was published in the transactions of the society for the year named.

Among the "very respectable and ingenious men" to whom Mr. Latrobe makes reference he undoubtedly included Hon. Robert R. Livingston, though he does not give his name. Mr. Livingston was a statesman and jurist of renown in his time, and a member of a family distinguished through several generations for its ability and its prominence in public affairs. He was born in New York City in 1746 and died in 1813, was a member of the second Continental Congress and one of the committee of five to draft the Declaration of Independence. He was absent from Philadelphia on the memorable Fourth of July, 1776, and consequently his name does not appear among the signers of the celebrated document, but he took an active part in the revolutionary measures, was again a member of Congress in 1780, and Secretary of Foreign Affairs from 1781 to 1783.

Livingston was a member of the convention that framed the first constitution of the State of New York, which was adopted in 1777, and was the first chancellor of the State, holding the office till 1801. For this reason he is generally known as Chancellor Livingston; in this capacity he administered the oath of office to Washington on his first assumption of the duties of President in 1879. In 1801 he was appointed Minister of the United States to France, and two years later he negotiated the purchase of the territory of Louisiana from the French Government. He resigned his official position in 1804 and returned to America in 1805.

In addition to public affairs Chancellor Livingston took great interest in mechanical, industrial, scientific, and artistic matters, and was constantly alive to measures that would increase the prosperity of his country and the intelligence of its citizens. The experiments of Fitch and Rumsey drew his attention to the problem of moving boats by steam, and he realized the great benefits that would come from the successful adoption of steamboats in the navigation of the rivers and lakes of the United States. According to Mr. Colden "he applied himself with uncommon energy and perseverance and at great expense to constructing vessels and machinery for that kind of navigation. As early as 1798 he believed that he had accomplished his object and represented to the Legislature of the State of New York that he was possessed of a mode of applying the steam-engine to propel a boat on new and advantageous principles; but that he was deterred from carrying it into effect by the uncertainty and hazard of a very expensive experiment, unless he could be assured of an exclusive advantage from it should it be found successful.

"The Legislature, in March, 1798, passed an act vesting Mr. Livingston with the exclusive right and privilege of navigating all kinds of boats, which might be propelled by the force of fire or steam, on all the waters within the territory or jurisdiction of the State of New York, for the term of twenty years from the passing of the act; upon condition that he should within a twelvemonth build such a boat, the mean of whose progress should not be less than four miles an hour."

Dr. Mitchell of New York introduced the bill, and it was received with much opposition, principally by the lawyers and wags in the house. The project was deemed idle and whimsical and quite unworthy the attention of the Legislature, and the introducer of the bill had his temper sorely tried by the number and character of the jokes that were made concerning it. In the State

Senate it was regarded in the same way, and one Senator said that whenever the younger members desired a little fun they would call up the steamboat bill and indulge in ridicule of the project and its advocates. When the bill was passed it was looked upon more as a joke than any thing else by the majority of the members, and some of them were quite willing to give Mr. Livingston a monopoly for a hundred or a thousand years, as they did not believe the scheme would ever amount to any thing.

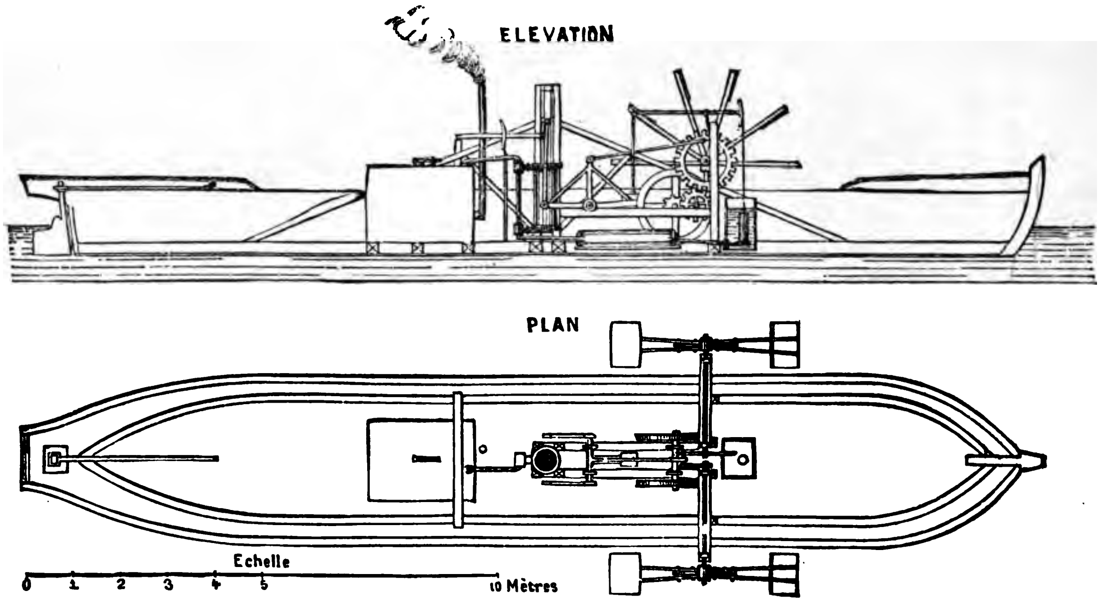
As soon as the act was passed Mr. Livingston built a boat of about thirty tons' burthen to be propelled by steam, but she was deficient in speed and did not meet the requirements of the law. The year allowed for the preliminary trial elapsed and the project was abandoned for a time, though the Chancellor does not seem to have been discouraged. His departure for France occurred soon after the discontinuance of the enterprise, and little was said about steamboats in the United States until a few years afterwards.

Livingston and Fulton became acquainted in Paris and it was quite natural that they should be drawn closely together from their interest in the great problem which occupied both their minds. They had many consultations and conferences which resulted in a determination to build an experimental boat at their joint expense. In 1802

Mr. Fulton went to Plombieres, France, to accompany Mrs. Barlow, who had been sent there by her physician, and while at Plombieres he tried some models of boats which he constructed with his own hands. In the latter part of the same year the construction of the steamboat was begun at Paris and it was completed early in the spring of 1803.

It was placed in the Seine, and Mr. Fulton and Mr. Livingston were preparing to invite their friends and others to witness the experiment when, early one morning, the former gentleman was roused by a messenger who came to tell him that the boat had broken in pieces and gone to the bottom of the river. In narrating the incident afterwards the inventor said the news created a despondency he had never felt before, but the sensation was only momentary. Without waiting for his breakfast he hurried to the spot where the boat had been moored to the bank, and unhappily found that the messenger's story was correct. The frame of the boat was too weak to support the weight of the machinery ; a gale had been blowing during the night, and the agitation of the water had caused the craft to break in two. She lay at the bottom of the river and not a vestige of her was visible above the surface of the water.

Without returning to his lodgings, Fulton went to work to raise what was left of his boat, and within twenty-four hours he had the machinery and



Fulton's First Steamboat—1803.

the fragments of the hull safe on land, with the exception of a few unimportant pieces. But the destruction was so complete that it was necessary to rebuild the boat entirely, and the work was not accomplished until the following July. During the work of raising the boat Mr. Fulton was much of the time in the river up to his waist, and he took no rest or refreshment for the whole twenty-four hours. At that time of the year the water of the Seine is very cold, and the exposure and excitement brought on a pulmonary trouble which remained with him for the rest of his life. Much of his subsequent ill-health was attributed to this incident.

Though the boat was destroyed, the machinery was very little injured, and consequently the pecuniary damage was less than had first been supposed. Early in August Mr. Fulton wrote to the officers of the French National Institute, inviting them to witness the trial of the boat; they accepted the invitation, and the experiment took place in their presence, together with that of other distinguished citizens of Paris, and a considerable multitude attracted by idle curiosity. The boat was sixty-six feet long and eight feet wide, and was moved by wheels on the sides. The experiment was satisfactory, though the boat did not equal the expectations of her builders in point of speed. Mr. Fulton at once declared that the engines were not sufficiently powerful, and besides, there were many defects in their construction which could be remedied. Both Fulton and Livingston were satisfied with the result, and determined to build a larger and more powerful boat for the navigation of the Hudson River.

Mr. Livingston supplied the necessary funds, and Fulton at once ordered an engine from Messrs. Boulton & Watt, of Birmingham, which was to be built upon certain specifications which he furnished. He did not tell them the purposes for which it was intended, and consequently there was a correspondence concerning the engine, which caused considerable delay in the work. On his arrival in England, Fulton went to Birmingham and made some new specifications for the work, which was not pushed with any rapidity. By the terms of the contract the engine should have been in America in 1805, but it did not arrive until after Fulton's return in 1806.

At the same time Livingston wrote to his friends at home, and through their influence and action the Legislature of the State of New York passed a law renewing the exclusive privilege of navigating the waters of the State by steam, which had been previously granted to Mr. Livingston, but had lapsed in consequence of the failure of the experimental boat of 1798. In the new act Fulton's name was united with that of Livingston, the two being made joint grantees, and they were allowed two years in which to produce a steamboat of not less than twenty tons burthen, which should move with and against the current of the Hudson River at the rate of four miles an hour. A later law extended the limit of time for the trial to April, 1807.

While Fulton was at Plombieres, Mr. Barlow wrote him as follows :

* * * "I had a great talk with Livingston. He says he is perfectly satisfied with your experiments and calculations, but is always suspicious that the engine beating up and down will break the boat to pieces. He seems to be for trying the horizontal cylinder, or for returning to his mercurial engine. I see his mind is not settled, and he promises now to write you, which he says he should have done long ago, but he thought you were to be back every fortnight. He thinks the scale you talk of going on is much too large, and especially that part which respects the money. You converted him as to the preference of the wheels above all other modes, but he says they cannot be patented in America because a man (I forget his name) has proposed the same thing there. You will soon get his letter. Parker is highly gratified with your experiments; he wishes, however, something further to remove his doubts—about keeping the proportions and as to the loss of power in different velocities. He wishes to have another *barrelier* made, four times as strong as this or thereabouts, to see whether the proportional velocity would be the same when moving by the paddles as when moving by the fixture on shore. I should like to see this too. If you desire it, I can take this *barrelier* to Cala and see whether he can make another of the same volume four

times as strong, and know what it will cost. The relative velocities can be tried in Perrier's pond on the hill."

A week later he wrote again on the same subject:

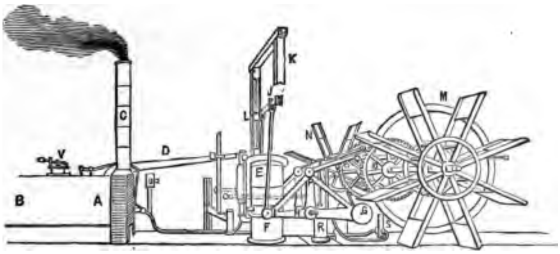
"Your reasoning is perfectly right about inventions and the spirit of the patent laws, and I have no doubt it may be secured in America. * * * My project would be that you should pass directly over to England, *silent and steady*, make Chapman construct an engine of twelve inches, while you are building a boat of a proportionate size. Make the experiments on that scale, *all quiet and quick*. If it answers, put the machinery on board a vessel and go directly to New York (ordering another engine as large as you please to follow you), then secure your patent and begin your operation, first small and then large. I think I will find you the funds without any noise for the first operation in England, and if it promises well you will get as many funds and friends in America as you want. I should suggest a small operation first, for several reasons: it can be made without noise. There must be imperfections in the first trial which you can remedy without disgrace if done without noise; you can easier find funds for a small experiment, etc. * * * I have talked with P. on your observations about great boats with merchandise."

CHAPTER VI.

Financial troubles of Fulton and Livingston—Launch and trial trip of the Clermont—Fulton's account of the first voyage to Albany—Consternation along the river—Dr. Perry's narrative—Improvements in the boat—Hostility of river men—Opposition and expensive litigation—" Pendulum boats."

WHILE occupied with his torpedo experiments, which have been already described, Mr. Fulton began the construction of the steamboat which was to navigate the Hudson and demonstrate the feasibility of the plans to which he and Chancellor Livingston had devoted their thoughts and their money. As is usually the case in affairs of this kind, he soon found that the expense of the construction was far beyond his calculations. He had agreed not to call upon Mr. Livingston for more than a certain amount, but circumstances obliged him to break this compact and, like Oliver Twist, ask for more. Mr. Livingston hesitated, and it was arranged that Fulton should dispose of one third of their joint rights, patents, and privileges in consideration of the needed capital.

Fulton made the offer to several gentlemen of means, and the fact that he had made it was widely known, but no one was willing to risk his money in such a wild scheme as the construction of a steamboat. Failure to obtain a third party to join them did not cause Fulton and Livingston to despair. Between them they advanced the additional money necessary for the completion of the work, and the enterprise went on. Livingston was wealthy but Fulton was not, and it is probable that the latter had considerable difficulty in providing his share of the funds.



Engine of the Clermont—1807.

In a recent issue of the *New York Times* the following anecdote appeared :

" Ha, ha!" said a charming old gentleman whose memory was wonderful for his age, for he was born during the first ten years of the present century. " Inventions! You can't get them always right. You see the inventive faculty is one thing and the business talent to work out inventions successfully something else. A good many people have the first, but very few the other. There was my father and Robert Fulton. It 's a family story. I dare say it has been in print often and often, but you can't wear out a good thing. You see, my father and Fulton were quite intimate. Fulton was in the habit of coming to see my father, and, having steamboat on the brain, he probably talked my father, John McKesson, to death. It was always endless chains or something or other. My father was a patient listener, and that 's a talent. One day during office hours Fulton came to see my father.

"'John,' said he, 'I have got it sure. I can make her go.'

"'I am too busy to listen to you now, Fulton. I tell you what you do, come round to my house to-night.'

"'I can't,' said Fulton. 'What I want to see you about is this: I must have $1,000.'

"'Well, I have n't got it to give you. But anyhow, come to the house all the same. You can take tea with us. Then you can talk with me up to ten o'clock at night; then if you are not through I shall go to sleep. I always go to bed at ten.'

"Fulton seemed to hesitate for a while, and at last said he would come. Fulton did come round, and took tea with father. Fulton told him about the paddle-wheel. Father thought that a paddle-wheel would never do. You see, in those times they were cocksure that the power used to lift up the water by the wheel would about neutralize the propelling force. Ha! ha! those old fellows were smart. We always are in our generation.

"'Well,' father said, 'Robert Fulton, your wheel is no good. It would never work. You talk about making the boat go four miles an hour! That 's an unheard of speed. No, sir. With a wheel on your boat she 'd stand stock still.'

"Then Robert Fulton argued it out with father, and ten o'clock came, and father was getting sleepy. Just then maybe Fulton got more excited, or father more attentive, and it was eleven o'clock and they were talking over it still.

"'It is time for you to go home, Robert,' said my father, 'unless you would like to have a bed here, and you might as well do that.'

"'If I do,' answered Fulton, 'I only adjourn the talk until to-morrow, for you must get me the $1,000.' Maybe Fulton buttonholed father before breakfast. Anyhow, Fulton's persuasive powers overcame father's doubts, and he agreed that he would do his best to raise the $1,000 for Fulton. Right after breakfast father went out, and the first man he met was Robert Lenox. 'See here, Mr. Lenox,' said father, 'I want some money from you to help one of Fulton's schemes. You may not believe it ever will be done, but the man fancies that he can make a boat go four miles an hour. I think he intends using steam, and a wheel, or something. I am going to let him have $100. Would you mind putting down your name for the same sum?'

"'It seems quite preposterous,' said Mr. Lenox to my father, 'and I have no reason to belive that Mr. Fulton's boat will ever accomplish what he thinks it will. Still, if your name is down, you may let him have $100 from me.'

"'Then,' said my father, 'I will write down "Robert Lenox, $100."'

"'No, no,' answered Mr. Lenox, 'just put down the $100 with no name to it, because I should n't like the people who come after me to learn that I was such a dunce as to think that Fulton or anybody else ever could make a boat go with steam or wheels four miles an hour.'

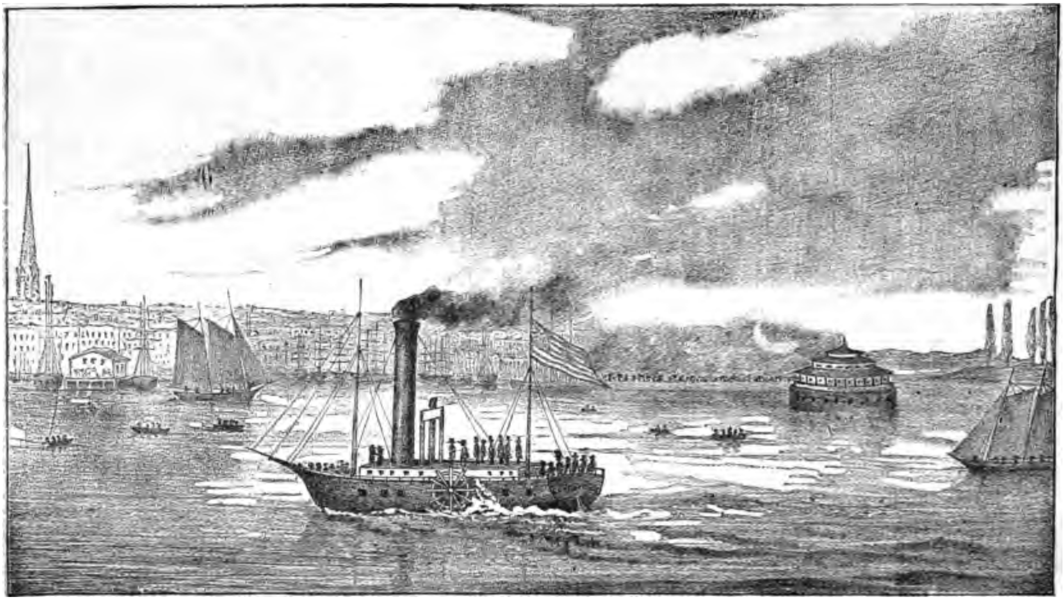
"That 's the story my father told me. See here," said the pleasant old gentleman, "you never can exactly tell what does come from an invention. I wonder what Fulton would have to say could he learn how those rocks at Hell Gate had to be blown up because they bothered that fleet of steamers which has to pass there every day.

Eh? eh?" and the old gentleman gave here a merry laugh. "Anyhow, Robert Fulton got his $1,000."

The boat was built at the ship-yard of Charles Brown on the East River, and was completed early in the spring of 1807. It took some time to place the engine on board, and it was not until August of the same year that she was ready for trial. Early one morning her engines were put in motion and she was moved from the ship-yard to the Jersey shore; it was found that she steered easily, and her progress was satisfactory to her owners.

There were few spectators on land, as at that hour most persons were in bed, and no announcement had been made of the intended transfer. There was a good deal of excitement, however, among the crews of vessels in the harbor as they saw a boat going through the water without the aid of sails, and even without masts for carrying them. Many of the sailors regarded the new craft with superstitious dread, as they had heard nothing about it and were unaware of the power of steam.

The boat was 130 feet long, 16½ feet wide, and 4 feet deep, and measured 160 tons by the custom-house regulations then in force. The engine had a steam cylinder 24 inches in diameter, and a stroke of 4 feet. The boiler was 20 feet long, 7 feet deep, and 8 feet wide. The wheels were 15 feet in diameter, with floats of 4 feet length and 2 feet dip.



Departure of the "Clermont" on her first voyage.

A day or two after the transfer Fulton and Livingston invited their friends to witness the trial of the steamboat and there was a public announcement of the affair which drew a considerable assemblage of people. Among the special guests was Dr. Mitchell, the gentleman who secured the passage of the first bill which gave Livingston the exclusive privilege of steam navigation in the waters of New York for twenty years, and there were also several other members of the Legislature. Invitations were also sent to gentlemen who had opposed the project and denounced it as ridiculous; some of them came to witness what they expected would be a failure, but others declined to be present as they were unwilling to treat the affair as worthy of consideration.

Concerning the trial trip Mr. Colden writes as follows:

"Nothing could exceed the surprise and admiration of all who witnessed the experiment. The minds of the most incredulous were changed in a few minutes. Before the boat had made the progress of a quarter of a mile, the greatest unbeliever must have been converted. The man who, while he looked on the expensive machine, thanked his stars that he had more wisdom than to waste his money on such idle schemes, changed the expression of his features as the boat moved from the wharf and gained her speed; his complacent smile gradually stiffened into an expression of wonder. The jeers of the ignorant, who had neither sense nor feeling enough to suppress their contemptuous ridicule and rude jokes, were silenced for a moment by a vulgar astonishment, which deprived them of the power of utterance, till the triumph of genius extorted from the incredulous multitude which crowded the shores, shouts and acclamations of congratulation and applause."

During this trial trip Fulton perceived an error in the form of the wheels; after a run of a few miles she returned to her starting-point and the inventor caused the diameter of the buckets to be lessened so that they did not dip so deeply in the water. Another trial was then made, and it was found that her speed improved under the alteration. Shortly after the trial the boat was advertised to run to Albany, and as soon as she could be got in readiness the "CLERMONT" sailed on her first voyage up the Hudson.

The date of the departure of this memorable trip is differently given by several writers, but the weight of evidence is in favor of Monday, August 11th. Mr. Fulton wrote the following letter after his return:

"NEW YORK, *Sept.* 15, 1807.

"*To the Editor of the 'American Citizen,'*

"SIR:—I arrived this afternoon, at four o'clock, in the steamboat from Albany. As the success of my experiment gives me great hopes that such boats may be rendered of great importance to my country, to prevent erroneous opinions and give some satisfaction to the friends of useful improvements, you will have the goodness to publish the following statement of facts:

"I left New York on Monday at one o'clock, and arrived at Clermont, the seat of Chancellor Livingston, at one o'clock on Tuesday—time, twenty-four hours, distance, one hundred and ten miles. On Wednesday, I departed from the Chancellor's at nine in the morning, and arrived at Albany at five in the afternoon—distance, forty miles, time, eight hours. The sum is one hundred and fifty miles in thirty-two hours, equal to near five miles an hour.

"On Thursday, at nine o'clock in the morning, I left Albany, and arrived at the Chancellor's at six in the evening: I started from thence at seven, and arrived at New York at four in the afternoon—time, thirty hours, space run through, one hundred and fifty miles, equal to five miles an hour. Throughout my whole way, both going and returning, the wind was ahead; no advantage could be derived from my sails: the whole has, therefore, been performed by the power of the steam-engine.

"I am, sir, your obedient servant,

"ROBERT FULTON."

He gives the following account of the same voyage in a letter to his friend Mr. Barlow:

"My steamboat voyage to Albany and back has turned out rather more favorable than I had calculated. The distance from New York to Albany is one hundred and fifty miles: I ran it up in thirty-two hours, and down in thirty. I had a light breeze against me the whole way, both going and coming, and the voyage has been performed wholly by the power of the steam-engine. I overtook many sloops and schooners beating to windward, and parted with them as if they had been at anchor.

"The power of propelling boats by steam is now fully proved. The morning I left New York, there were not perhaps thirty persons in the city who believed that the boat would ever move one mile an hour, or be of the least utility; and while we were putting off from the wharf, which was crowded with spectators, I heard a number of sarcastic remarks. This is the way in which ignorant men compliment what they call philosophers and projectors.

"Having employed much time, money, and zeal, in accomplishing this work, it gives me, as it will you, great pleasure to see it fully answer my expectations. It will give a cheap and quick conveyance to the merchandise on the Mississippi, Missouri, and other great rivers, which are now laying open their treasures to the enterprise of our countrymen; and although the prospect of personal emolument has been some inducement to me, yet I feel infinitely more pleasure in reflecting on the immense advantage my country will derive from the invention," etc.

The passengers on board the boat, on her first passage as a Packet, published a statement, over their signatures, that the speed, accommodations, and conveniences far exceed their most sanguine expectations.

The following letter tells how the people along the river were excited by the passage of the steamboat on her voyage from New York to Albany:

"SOUDERSBURG, LANCASTER CO., *Jan.* 4, 1856.

"J. FRANKLIN REIGART, Esq.

"DEAR SIR:—Having been informed that you are about to publish a history of Robert Fulton, who was distinguished for many noble inventions, allow me to state that the publication of the narrative of facts as they happened, and the description of his productions, would be exceedingly interesting to the admirers of genius and every lover of the arts and sciences. The works of Fulton are now justly appreciated, and the citizens of this matchless county will forever honor the name and birthplace of his genius.

"It was in the early autumn of the year 1807, that a knot of villagers was gathered on a high bluff just opposite Poughkeepsie, on the west bank of the Hudson, attracted by the appearance of a strange dark-looking craft, which was slowly making its way up the river. Some imagined it to be a sea-monster, whilst others did not hesitate to express their belief that it was a sign of the approaching judgment. What seemed strange in the vessel was the substitution of lofty and strange black smoke-pipes, rising from the deck, instead of the gracefully tapered masts that commonly stood on the vessels navigating the stream, and, in place of the spars and rigging, the curious play of the working-beam and pistons, and the slow turning, and splashing of the huge and naked paddle-wheels, met the astonished gaze. The dense clouds of smoke, as they rose wave upon wave, added still more to the wonder of the rustics.

"This strange-looking craft was the Clermont, on her trial trip to Albany; and of the little knot of villagers above mentioned, the writer, then, a boy in his eighth year, with his parents, formed a part; and I well remember the scene, one so well fitted to impress a lasting picture upon the mind of a child accustomed to watch the vessels that passed up and down the river.

"The forms of four persons were distinctly visible on the deck, as she passed the bluff—one of whom, doubtless, was Robert Fulton, who had on board with him all the cherished hopes of years, the most precious cargo the wonderful boat could carry.

"On her return trip, the curiosity she excited was scarcely less intense—the whole country talked of nothing but the sea-monster, belching forth fire and smoke. The fishermen became terrified, and rowed homewards, and they saw nothing but destruction, devastating their fishing grounds; whilst the wreaths of black vapor, and rushing noise of the paddle-wheels, foaming with the stirred-up waters, produced great excitement amongst the boatmen, until it was more intelligent than before; for the character of that curious boat, and the nature of the enterprise which she was pioneering, had been ascertained. From that time Robert Fulton became known and respected as the author and builder of the first STEAM-PACKET; from which we plainly see the rapid improvemont in commerce and civilization. Who can doubt that Fulton's first packet boat has been the model steamer? Except in finer finish and greater size, there is no difference between it and the splendid steamships now crossing the Atlantic. Who can doubt that Fulton saw the meeting of all nations upon his boats, gathering together in unity and harmony, that the 'freedom of the seas would be the happiness of the earth'? Who can doubt that Fulton saw the world circumnavigated by steam, and that his invention was carrying the messages of freedom to every land, that no man could tell all its benefits, or describe all its wonders? 'What a wonderful achievement!' 'What a splendid triumph!' Fulton was a man of unparalleled foresight and perseverance. His character and genius rise higher in our estimation, and still more grandly before our minds, the more we contemplate him. To write this history requires the noblest effort, and I trust you will be able to accomplish it. With my best wishes for your success, I subscribe myself.

"Very respectfully yours,

"H. FREELAND."

The following letter descriptive of the first voyage of the Clermont from Albany was written by Fulton and sent to Chancellor Robert R. Livingston, grandfather of Clermont Livingston, in whose keeping the letter now is:

"NEW YORK,

"Saturday, the 28th of *August*, 1807.

"DEAR SIR:—On Saturday I wrote you that I arrived here on Friday at four o'clock, which made my voyage from Albany exactly thirty hours. We had a little wind on Friday morning, but no waves which produced any effect. I have been making every exertion to get off on Monday morning, but there has been much work to do—boarding all the sides, decking over the boiler and works, finishing each cabin with twelve berths to make them comfortable, and strengthening many parts of the iron work. So much to do, and the rain, which delays the caulkers, will, I fear, not let me off till Wednesday morning. Then, however, the boat will be as complete as she can be made—all strong and in good order and the men well organized, and I hope, nothing to do but to run her for six weeks or two months. The first week, that is if she starts on Wednesday, she will make one trip to Albany and back. Every succeeding week she will run three trips—that is, two to Albany and one to New York, or two to New York and one to Albany always having Sunday and four nights for rest to the crew. By carrying for the usual price there can be no doubt but the steamboat will have the preference because of the certainty and agreeable movements. I have seen the captain of the fine sloop from Hudson. He says the average of his passages have been forty-eight hours. For the steamboat it would have been thirty certain. The persons who came down with me were so much pleased that they said were she established to run periodically they never would go in any thing else. I will have her registered and every thing done which I can recollect. Every thing looks well and I have no doubt will be very productive.

"Yours truly,

"ROBERT FULTON."

"You may look for me Thursday morning about seven o'clock. I think it would be well to write to your brother Edward to get information on the velocity of the Mississippi, the size and form of the boats used, the number of hands and quantity of tons in each boat, the number of miles they make against the current in twelve hours, and the quantity of tons which go up the river in a year. On this point beg of him to be accurate."

Having been informed that Dr. William Perry of Exeter, New Hampshire, was a passenger on the Clermont on her first voyage, the author of this volume addressed him on the subject and received the following reply:

"EXETER, N. H., *June* 12, 1885.

"Col. THOMAS W. KNOX.

"MY DEAR SIR:—You may remember me in connection with the *Cincinnati Gazette* and the Philadelphia Exposition.

"For some years I have been living quietly in this my native town, contributing to the *Cincinnati Commercial Gazette*, and other western papers and periodicals, and living within reach of my father, to whom you have just written. He is in good health, neither blind nor deaf, and with no internal disorder, his only trouble being that his legs are weak, so that his walks must be short and slow. He was born Dec, 20, 1788, and is now the oldest living graduate of Harvard. He writes letters occasionally, but not as readily as once, so I have volunteered to take down what he has to say, and will give it in his own words and in the first person. I ought to premise that the voyage he describes was not the trial trip of the skeleton of Fulton's steamer in 1807, but its first voyage with passengers in the spring of 1808. Now for the narrative.

"Sincerely yours,

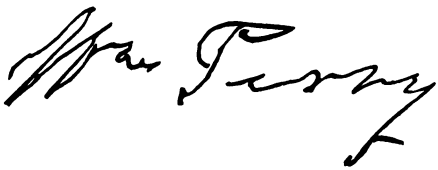
"JOHN T. PERRY."

"In April, 1808, I left Union College, Schenectady, where my brother, the late Gardiner B. Perry, D. D., had been tutor, to go to my birthplace, Norton, Mass., and to enter Harvard College in the fall, for which last my stay in Schenectady had been a preparation. I was then in my twentieth year, and had in charge a lady from Hartford, who was on her way home. On reaching Albany, I found that none of the sail boats, then in use, were to start for several days. So I engaged a room for myself at a public house, the lady going to the house of some friends. Early the next morning a man, evidently a person who loved his glass, rushed into the bar-room and cried out that the steamboat had come in during the night and would go down river at nine o'clock. It took so much time to hunt up my charge, and she was so long in getting ready, that the boat had started when we reached the wharf. I hailed her, however, and a small boat was sent out to take us on board. There were more than fifty passengers, many of them youths and children. I soon noticed Mr. Fulton, who was watching and directing every thing. He was of medium height, slimly built, and so much absorbed in looking after the craft that he had no time or inclination to talk with any one. I once saw him leaning in an absorbed manner over a chair. He had a shoe on one foot, and only a stocking on the other. I looked over the stern of the boat and read the name 'Katherine of Clermont.' It was that of Fulton's wife, daughter of the Livingston of Clermont Manor. Most accounts say the title was simply 'The Clermont,' but I cannot be mistaken. She was a common open river boat about one hundred and twenty-five feet long, with no deck, and the boys were running about everywhere. The only cabin was a small room over the bows. It was claimed that the Katherine would run six miles an hour, but she did not make that time. Her paddle wheels were at the side, and her tube (or smoke-stack) was of sheet iron. I think my fare to Kingston was three dollars.

"The first part of the voyage was quiet enough, but in the afternoon we ran aground, as many thought, through the treachery of some of the crew, for the owners of sloops and other sailing craft were much in dread of the result of the successful inauguration of steam power. I got off at Esopus —now Kingston—as did my companion, and so missed being present at the bursting of the boiler, which occurred near West Point. Being of sheet iron no damage was done besides stopping the works and frightening the passengers. A week or ten days later I was in New York, going there in a sloop. The steamer, which I hunted up, was undergoing repairs at the docks.

"Among the passengers was a Mr. Lyon, a member of Congress from Connecticut or Vermont, I forget which, who was quite notorious at the time on account of a hand-to-hand encounter at Washington on the floor of the House. He kept away from the crowd most of the time, staying in the little cabin.

"As I have said, the owners of sailing craft were jealous of Fulton, and soon after they got an injunction, restraining him from using his steamboat, on the ground that the navigation of the river belonged to them. He secured Daniel Webster for his counsel, and won his case, though he afterward had much trouble about patent rights. The case was a very important one, not only in the principle involved, but on account of the number and influence of Fulton's opponents."



The signature to the letter as herewith printed is a *fac-simile* of the signature appended to the original by Dr. Perry.

The reader will note Dr. Perry's statement that the name of the steamer was "Katherine of Clermont." The author has examined all accessible biographies of Fulton and accounts of the inauguration of steamboats on the Hudson, and in none of them does he find the steamer designated otherwise than as the Clermont. In 1805 Mr. Fulton married Harriet, daughter of Walter Livingston, who was a relative of Fulton's friend and partner, Chancellor Livingston, consequently Dr. Perry is not correct in giving the name of Fulton's wife as Katherine, and his memory may be equally at fault respecting the appellation of the steamboat, though there cannot be the least doubt of his entire sincerity. He has long been a prominent citizen of Exeter, and is greatly beloved and revered by his fellow townsmen.

During the autumn of 1807 the Clermont continued to run as a packet, and so great was the curiosity concerning her and the appreciation of her quick passages, that she nearly always had as many passengers as she could accommodate. Several accidents occurred to her machinery owing to defects in its construction, but none of them caused any loss of life; there were so many of these mishaps, however, that the incredulous were encouraged in the belief that she was a failure, and numerous predictions were made that she would never resume her trips after the end of the year. In some respects she was a disappointment to Fulton, as she did not meet his calculations in regard to speed, and he spent much of his time in trying to discover the cause of the deficiency. His friends say that in every instance he found it was due to faults of construction either of boat or engines, and not to any error in his own figures; he made plans for alterations while she was still on the route, and as soon as she was laid up for the winter he began the work of overhauling.

The shafts of the wheels were originally made of cast iron, which was found incapable of sustaining the weight of the wheels and the power applied to them. Several breakages occurred during the first season; while laid up for the winter the boat was provided with wrought-iron shafts, which prevented a recurrence of these mishaps. Then, too, there were no supports for the outward ends of the shafts and the wheels were entirely exposed to view. During the winter the Clermont was extended to a length of one hundred and forty feet while her beam, originally sixteen and one half feet, remained unchanged. The shafts of the wheels were provided with wheel-guards or outer supports, and several minor improvements were made in the machinery and fittings of the boat; altogether the

Clermont of 1808 was a considerable advance upon the Clermont of 1807.

But the misfortunes of the boat were not limited to accidents to machinery and other legitimate mishaps; they included wilful attempts at her destruction on the part of those who felt that their business was about to be injured by the new system of navigation. Vessels ran foul of her intentionally, and so determined were the sloop owners and others to rid themselves of this dangerous competitor that it was necessary for the Legislature to interfere. At its session in the winter of 1807–8 a law was passed to prolong for five years the exclusive privilege of Livingston and Fulton for each additional boat they should build and establish on the river; provided, that the whole time should not exceed thirty years from the passage of the law. A clause was added to this act declaring that combinations to destroy the Clermont or any other steamboat, or wilful attempts to injure her, were public offences punishable by fine and imprisonment.

Fulton was further annoyed, as suggested by Dr. Perry, by infringements of his patent rights. From the first his boat was open to the inspection of everybody, and naturally she attracted much attention. Not only was she visited by those who went from motives of curiosity, but by individuals who had an eye to business. Fulton had applied for patents soon after beginning the construction of the Clermont but as he progressed he made various improvements in the machinery which were not covered in his original applications. When the boat was completed and he had made her trial trip there were obvious improvements which would suggest themselves to an intelligent mechanic as readily as to the builder himself. One of these improvements was the wheel-guard, or outer support for the wheel-shafts, which has been already mentioned; it is said to have been thought of by Fulton before the launching of the boat, but was not made owing to lack of time and the necessity of economy. Some of, the visiting mechanics who had scoffed at the steamboat as the idle fancy of a dreamer did not hesitate to take out patents for improvements on his work; they were even audacious enough to apply for patents covering the devices which had already been recorded to Fulton's credit in the archives of the patent office.

Litigation threatened to swallow up all the proceeds of the enterprise, and to litigation was added competition from the builders of rival steamboats. These men defied the law by which Fulton and Livingston had received exclusive privileges, and employed counsel to find loopholes in the act of the Legislature. As a coach and six can be driven through an act of the British Parliament, in like manner a steamboat can pass through a law of the

State of New York with less liability to injury than in the tortuous channel of Harlem River.

History repeated itself in the case of Fulton as it has repeated itself in the case of every inventor whose invention proves successful. Human nature is the same in all ages, and until the millennium comes every inventor whose work promises to yield a pecuniary advantage will be assailed by unprincipled men who would rob him of glory, profit, and good name, in order to benefit themselves. Such is the history of inventions from the day that patent laws were first enacted, down to the moment these lines are written, and such will it be until patent laws are no longer needed, because the world is so filled with inventions that it can contain no more.

Fulton's first patent for improvements in navigation by steam is dated February eleventh, 1809; on the ninth of February, 1811, he took out a second patent for improvements which covered the boats and machinery. But others had gone ahead of him in patenting some of his own inventions, and hence his expensive and dispiriting litigation.

One of the devices by which attempts were made to defraud him was a boat to be run by a pendulum. An ingenious, and alleged respectable, gentleman constructed a boat of this sort; while she lay on the stocks and her wheels were in the air and met no resistance the machinery performed very well when the pendulum was set in motion. But as soon as the boat was put in the water it was found that the pendulum would not propel the machinery without the application of a great power to the pendulum, and the only power the inventor could think of was STEAM; so he rigged up a steam engine to run the pendulum while the pendulum was to run the boat! He obtained a patent for this product of his genius, and as Fulton had demonstrated the commercial advantages of boats propelled by some other power than the wind, he had no difficulty in obtaining abundant capital for building pendulum boats and paying for the litigation which sought to drive Fulton into poverty and disgrace.

On this subject, Mr. Colden says, pages 185 and 186:

"Messrs. Livingston and Fulton attempted to vindicate their rights and to stop these boats by an application to the Circuit Court of the United States for an injunction, but the judge decided that he had not jurisdiction in the case. They then made the same application to the Court of Chancery of the State, but the Chancellor, after hearing an argument for several days, refused to grant an injunction. From this decision there was an appeal, and, in the winter of 1812, the Court of Errors, which, when the appeal is from Chancery, is composed of the Senate of the State and the five judges of the Supreme Court, unanimously reversed the decision of the Chancellor and ordered a perpetual injunction, so that the boats could no more be moved with steam than they could with a pendulum.

"The true merits of the members of this Pendulum Company were happily exposed in the learned, eloquent, and ingenious argument which Mr. Emmet, as counsel for the appellants, made on this occasion before the Court of Errors. In characterizing the members of this company and contrasting them with Mr. Fulton, he described them as 'men who never wasted health and life in midnight vigils and painful study; who never dreamt of science in the broken slumbers of an exhausted mind; who bestowed on the construction of a steamboat just as much mathematical calculation and philosophical research as in the purchase of a sack of wheat or a barrel of ashes.'"

The laws having proved insufficient to prevent the building and running of boats in opposition to the rights of Fulton and Livingston, the Legislature in 1811 passed a supplementary act for their relief. In this act certain summary remedies were provided against such persons as should violate the existing laws, but though they restricted, they could not wholly suppress the competition. Two boats which were then running on the Hudson, and one on Lake Champlain, were exempted from the provisions of this act. This exemption was not intended as a compromise measure or as an approval of their opposition, but because the summary proceedings might be considered, in application to these boats, as having an *ex-post-facto* character, and would, therefore, be in violation of the Constitution of the United States. In regard to these existing boats, Fulton and Livingston were in the same position as before the passage of the act.

CHAPTER VII.

The successors of the Clermont—Increase of speed—East River ferry-boats—The "horse-ferry"—Boat on Long Island Sound—Boats on the Mississippi—Plans for a war steamer—The first war steamer in the world—Her description, performance, and fate—The death of Fulton.

ALL the pictures of the Clermont represent her as having a hull much like that of the sloop of the time and equipped with two small masts and a bowsprit. The funnel was much taller in proportion to the side of the boat than is the case with the steamboats of the present time, but this may have

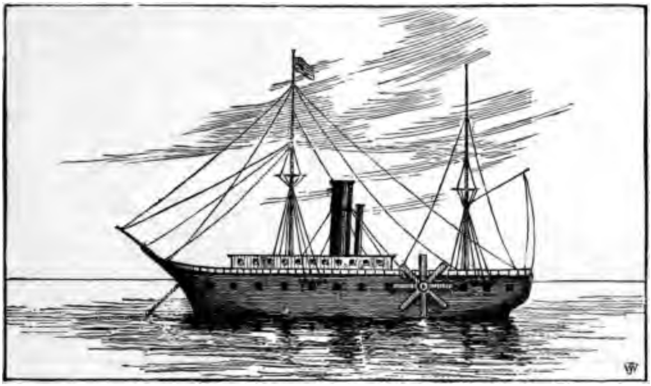
Clermont, 1807.

arisen from the fact that she burned pine wood and required excessive draft to her furnaces. As she poured forth volumes of smoke by day and showers of sparks by night it is no wonder that she filled the minds of the sailors on the river and the inhabitants along its banks with the direst apprehensions of impending calamities.

The picture representing the departure of the Clermont on her first voyage is reproduced from Reigart's Biography of Fulton. As Mr. Reigart had access to the papers and drawings in possession of Mr. Fulton's family it is asssumed that the sketch is authentic.

The first voyage of the Clermont demonstrated beyond a doubt the advantages which a steamboat possessed over the sailing craft of the time. With the vicissitudes of wind and tide the sloops and schooners then navigating the Hudson were frequently a week or more between New York and Albany, and a passage of four days was considered a remarkably short one. Accomplishing the upward journey in thirty-two hours' running time and the downward one in thirty, the Clermont settled the question of competition between sails and steam in a way that left no room for discussion. Time was of consequence to the traveller of those days as in the present, and in no other way could the new craft appeal more strongly to the American mind than in shortening the voyage of the Hudson by more than three fourths. When she began running regularly as a passenger packet she made the round trip in seventy-two hours, so that a merchant could count on going to Albany and returning to New York in less time than he had formerly required for the journey either way.

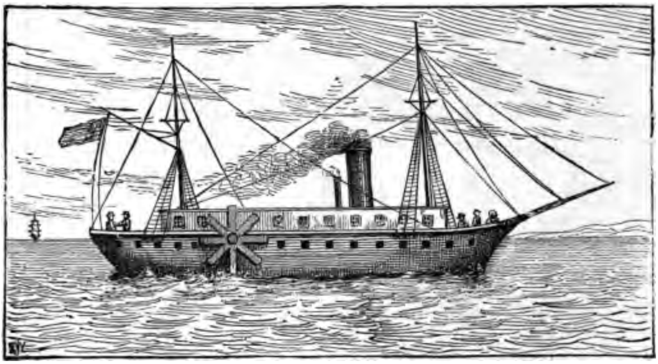
The fares were certainly high enough to be remunerative if the boats were even moderately patronized. They were as follows: From New York to Verplanck's Point, $2; West Point, $2.50; Newburg, $3; Wappinger's Creek, $3.25; Pough-



Car of Neptune, 1808.

keepsie, $3.50; Hudson, $5, and to Albany $7. All other passengers besides those bound to the regular landings were charged $1 for every twenty miles, and the advertisement calls particular attention to the fact that no one would be taken on board or put ashore for less than $1, however short the distance was.

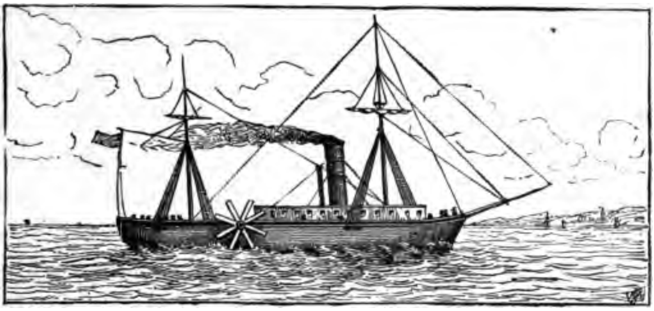
Other steamboats were built and put on the route, and in less than two years from the first voyage of the Clermont there was a regular service between the commercial and political capitals of the Empire State. The Car of Neptune, a boat of 295 tons measurement, was the immediate successor of the Clermont; then came the Paragon in 1811, and then other steamers, the exact dates of whose construction is unknown. An advertisement in a newspaper of 1813 informs the public that the Paragon, Capt. Niswall, will leave New



Paragon, 1811.

York every Saturday evening at 5 o'clock for Albany, the Car of Neptune, Capt. Roorback, every Thursday afternoon, and the North River, Capt. Bartholomew, every Tuesday afternoon at the same hour. Before 1817 the time of the passage from New York to Albany was reduced to eighteen hours.

Compared with the boats of the present time, the Clermont and her sisters were the crudest sort of craft, with slender accommodations for passengers, and limited freight capacity. No great improvement was made in them until after 1820, when newer and more commodious boats made their appearance, and the original steamers were withdrawn. Competition was of benefit to the public, however much it might be detrimental to the interests of the pioneers in steam navigation, and as soon as the monopoly was broken there was an abundance of



Raritan, 1808.

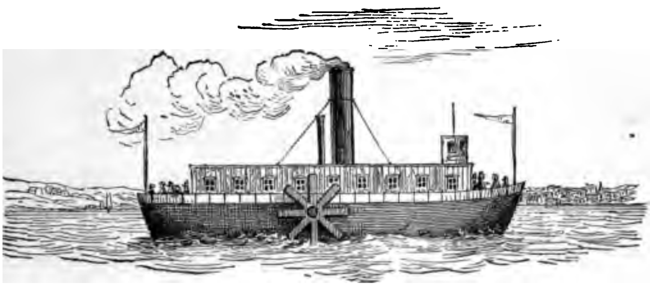
capital ready for investment in steamboat enterprises.

The first important improvement of which any record has been preserved dates from 1826, when advertisements in the papers announced that the new and splendid steamboats Constellation and Constitution would run daily between the metropolis and the capital during the summer. The bills assured the public that these boats were first class, "and for any accommodation, speed, quiet motion of engines, and skilful management, were not surpassed by any boats." They reduced the time of the journey to about fifteen hours, and the competition made a material decrease in the fares.

In regard to the speed of boats, the captain of one of the river steamers now running said recently:

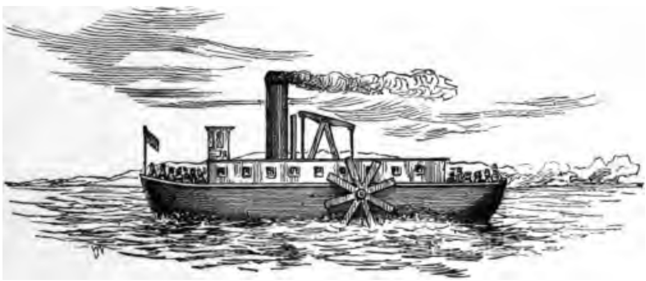
"In 1836 the old North American made a trip in ten hours twenty minutes; in 1840 the Albany reduced the time to eight hours twenty-seven minutes; in 1841 the South American did it in seven hours twenty-eight minutes; in 1849 the Alida, since cut down to a towboat, made a record of seven hours forty-five minutes; in 1852 the Francis Skiddy, a famous boat in her time, covered the distance in seven hours twenty-four minutes. But it was not until 1862 that the figure seven was knocked off the record by the Daniel Drew, which rang her bell at each end of the course in nine minutes less than seven hours, and in 1864 the Chauncey Vibbard did the same in another nine minutes less. Since that day the time on the river has not improved."

But to return to Mr. Fulton. There was great need of boats for crossing the North and East rivers, and his attention was called to the subject. In 1811 and 1812 he built two ferry-boats for crossing the Hudson River from New York to the Jersey shore, and shortly after he constructed a similar boat for the East River. Mr. Colden says these were what are called twin boats, each of them being two complete hulls, united by a deck or bridge; they were sharp at both ends, and could move



York (ferry-boat), 1811.

equally well with either end foremost, so that they crossed and recrossed without turning about. He contrived also, says Mr. Colden, floating docks for



Fire-Fly (ferry-boat), 1812.

the reception of these boats, and a means by which they were brought to them without a shock.

This description will answer very well for the ferry-boats that connect New York with neighboring shores in this latter half of the nineteenth century. The double-ender steamboat and the pontoon to which it is attached at either end of the route were the invention of the man who built the pioneer steamboat for the Hudson. His name is preserved in Fulton Ferry, the principal of all the ferries connecting New York with Long Island, and in the streets running from it on either side of the East River. How many of the thousands who daily cross by Fulton Ferry have ever known or cared to know whence its name was derived?

Mr. Fulton wrote and published a description of these boats in the *American Medical and Philosophical Register* for October, 1812. In the course of the description he says:

"In a new combination of this kind it is not to be expected that every thing should work to the best advantage in a first experiment; or that every requisite should be foreseen. The boat which I am now constructing will have some important improvements, particularly in the power of the engine to overcome strong ebb-tides; from which again other improvements will be made as in all new inventions. The present boat crosses the river, which is a mile and a half broad, when it is calm, in fifteen minutes; the average time is twenty minutes. She has had in her at one time eight four-wheel carriages, twenty-nine horses, and one hundred passengers, and could have taken three hundred persons more."

Previous to the introduction of steam the East River was crossed by means of row-boats and also by "horse-boats." The latter have been thus described by Mr. Banvard, who was once famous as the exhibitor of a panorama of the Mississippi:

"How well I remember the horse-boat that paddled
'Cross the East River ere the advent of steam,
Sometimes the old driver the horses would straddle,
And sometimes ride 'round on the circling beam.

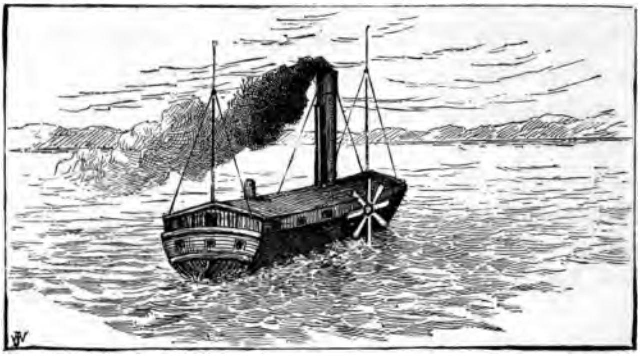
"The old wheel would creak and the driver would whistle
To force the blind horses to pull the wheel 'round,
And their backs were all scarr'd and stuck out in bristles,
For the driver's fierce stick their old bones would pound.

"The man at the gate, in fair weather or rainy,
Stood out in the storm by the cold river side,
With pockets capacious to hold all the pennies;
It took just four coppers to cross o'er the tide.

"The pilot, he, too, took the wind and the weather,
Perched over the horses, his tiller in hand;
Sometimes would the wind and the fierce tide together
Delay him in getting his boat to the land.

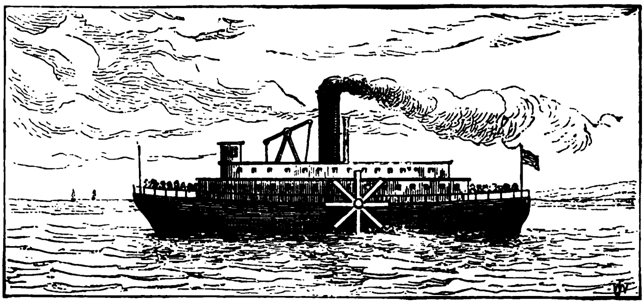
"Though four-horse was the power that ploughed the swift river,
Yet oft in his hurry has the passenger curs't,
Though no thought would come to make a man shiver
About the dread danger of boilers to burst."

In 1812 Mr. Fulton superintended the construction of the Camden, which began running at Philadelphia on the 9th of May of that year. Its route



Camden, 1812.

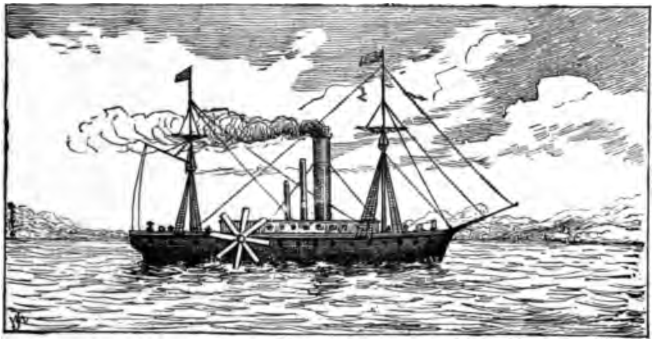
was from Market Street in that city to Springer's Ferry at Camden. In 1813 he built the steamers



Richmond, 1813.

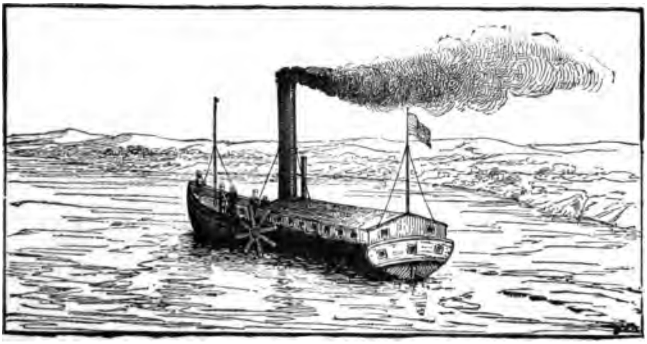
Richmond and Washington—the former of 370 and the latter of 275 tons, and also the Fulton, 327 tons. In the same year the ferry-boat

Nassau was built under his plans and direction. In 1814 the steamboat Vesuvius, 400 tons burthen,



Washington, 1813.

was launched at Pittsburgh, Pa., as a regular trader between the falls of the Ohio and New Orleans. In December of the same year Fulton made a con-

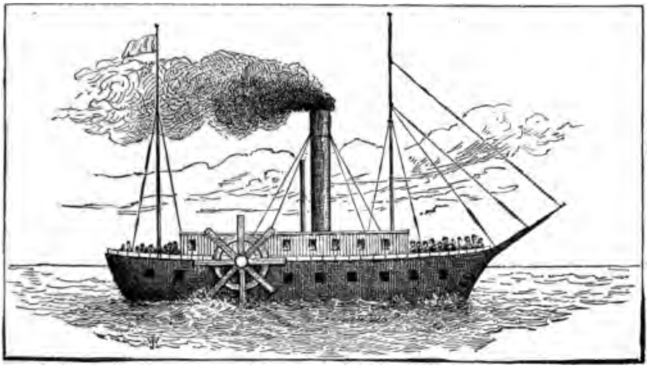


Nassau, 1813.

tract with the Government for the employment of his steamboats Vesuvius, Etna, New Orleans, Natchez, and Buffalo, as transports on the Mississippi and Ohio rivers, for the conveyance of troops and munitions of war. How many of these boats had been actually completed at the time the contract was signed, we cannot ascertain with exactness. The Vesuvius was at New Orleans at the time of the famous battle of the 8th of January, 1815, and is said to have been of great service to General Jackson in his arrangements for the defence of the city. She was impressed into the service of the Government Dec. 30, 1814, before the knowledge of Fulton's contract was known at New Orleans, and remained in government hands till the 12th of the following March. During a part of this time she was aground on a sand bar, and a claim was afterwards presented to the Government on behalf of her owners. The declaration of peace at the beginning of 1815 rendered the contract for the use of the steamboats abortive, and it was never carried out.

The Vesuvius was employed as a trading boat on the Mississippi until August, 1816, when she met the usual fate of western steamers. On the tenth of that month she was burned near New Orleans, and the loss on boat and cargo was estimated at $200,000.

The prices for freight and passage on the Mississippi in the early days of steamboating are preserved in the report which accompanied the claim of Fulton's heirs for damages for loss of services of the Vesuvius during the time she was in government employ. They were established by the Legislature of the State of Louisiana in 1812, and were not reduced until 1819.



Vesuvius, 1813.

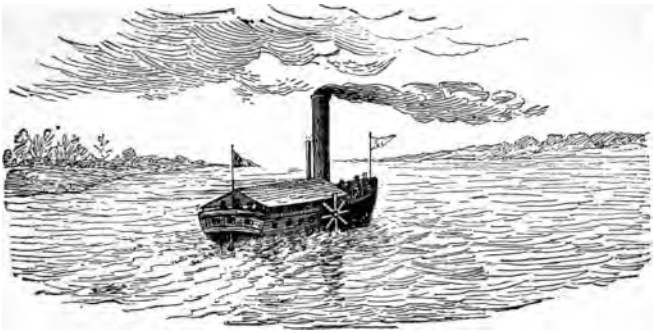
From New Orleans to Louisville, four and a half cents per pound for heavy goods, and six cents for light ; averaging five cents per pound, or per ton	**$112.05**
From New Orleans to Natchez, three fourths of a cent per pound, or $1.50 per barrel ; and the same rates were charged for all the intermediate landings—Donaldsonville, seventy-five miles, Baton Rouge, one hundred and twenty, etc., or per ton .	**15.00**
From New Orleans to Louisville, passage . .	**125.00**
From New Orleans to Natchez	**30.00**
And half price for passage down.	

Witnesses who were examined in connection with the claim testified that $600 a day would be a moderate allowance for her services for the period of her impressment. One of them declared that the steamer New Orleans, of very nearly the same tonnage as the Vesuvius, averaged $800 a day during an absence of forty days from New Orleans on a trip to Louisville.

The Chancellor Livingston, for the navigation of the Hudson River, was built upon the plans and specifications of Mr. Fulton, but was not completed until after his death. The last passenger boat planned by him and built upon his specifications was for the navigation of Long Island Sound between New York and New Haven. Mr. Colden said of her in 1817:

"She is nearly four hundred tons burthen, built with uncommon strength, and is fitted up with convenience and elegance; she is the first steamboat that had a round bottom like a ship. The form was adopted because, for a great part of her route, she would be as much exposed as she could be on the ocean. It was therefore necessary to make her a perfect sea-boat. She passes daily and at all times of the tide, the dangerous strait of Hell Gate, where, for the distance of nearly a mile, she often encounters a current running at the rate of at least six miles an hour. For some distance she has on either side of her rocks and whirlpools which rival Scylla and Charybdis, even as they are poetically described. This passage, previously to its being navigated by this vessel, was always supposed to be impassable except at certain stages of the tide, and many a shipwreck has been occasioned by a small mistake in the tide time. The boat passing through these whirlpools with rapidity, while the angry waters are foaming around her bows, and appear to raise themselves in obstinate resistance to her passage, is a proud triumph of human ingenuity. The owners, as the highest tribute they had in their power to offer to his genius, and as an evidence of the gratitude they owed him, called her the Fulton."

According to the returns made to the Comptroller of the State of New York at the end of 1818, the tax on passengers for 1817 and 1818 amounted to



Fulton, 1814.

$37,620.18, after deducting the expenses of collection. The gross amount of the steamboat tax for those two years was $41,440. Passengers under thirty miles paid no tax; over thirty and under one hundred miles the tax was fifty cents, and above one hundred miles one dollar. It was estimated that the receipts of the proprietors of steamboats from passengers alone amounted to seven times as much as the tax, or nearly three hundred thousand dollars. Fares were much higher than at present, and consequently the figures do not represent as many travellers as would the same amount of money in more modern days.

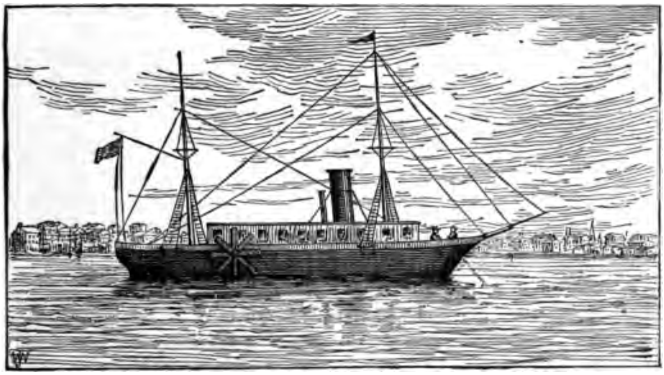
Though successful with steamboats for peaceful purposes, Fulton was not inactive respecting ships of war. While he was engaged with his various enterprises for navigating the Hudson and other rivers of the country, the war between England

Olive Branch, 1815.

and the United States came upon us and filled the minds of many citizens with alarm. The harbor of New York was regarded liable to entrance by the British fleet then hovering about the coast, and in the early part of 1814 a public assembly was called to devise means for its defence.

The meeting appointed a committee to be called the Coast and Harbor Defence Committee of New York, and as soon as it was organized it sent for

Mr. Fulton and asked what he had to suggest. After a brief delay he exhibited plans and specifications for a ship of war to be propelled by steam not less than four miles an hour, and carrying a battery of forty-four guns. The committee approved the design, and it was also favored by several distinguished officers of the navy. The names of Commodore Decatur, Captain Jones, Captain Evans, Captain

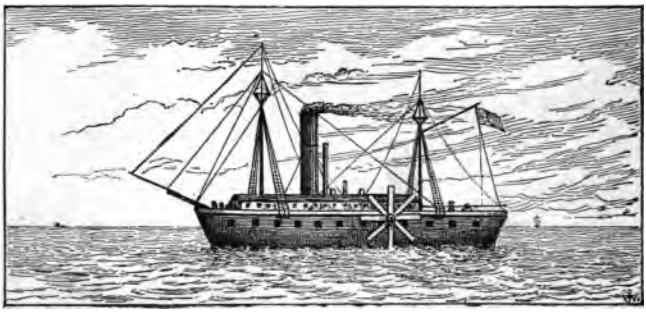


Emperor of Russia, 1815.

Biddle, Commodore Perry, Captain Warrington, and Captain Lewis, were signed to a document approving the plan, which was immediately forwarded to the authorities at Washington.

In their recommendation these naval officers said such a vessel would possess the following advantages: In a calm or light breeze she could make choice of position or distance. If she could move at the rate of four miles an hour she could, in our harbors, bays, and rivers, be rendered more formidable than any kind of engine hitherto invented, and in such case, she would be equal to the destruction of one or more seventy-fours, or of compelling them to depart from our waters. In addition to her armament, and her furnaces for red-hot shot, she was to be provided with submarine guns upon the plan which Fulton had already elaborated.

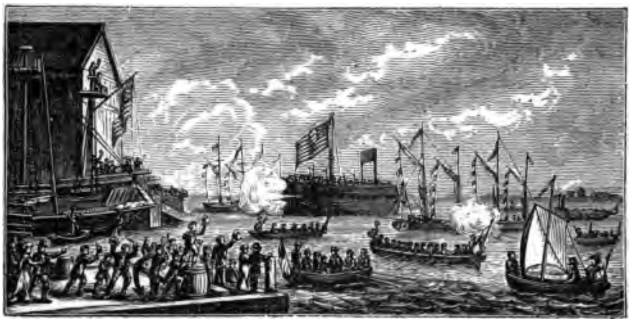
A memorial was sent to Congress by the com-



Original Plan of the Demologos.

mittee and also a letter to the Secretary of the Navy, soliciting his support of the measure. There was a difficulty about the matter, as the committee did not desire to have their operations made public through a debate in Congress, and at the same time the President and Cabinet could not expend the public money without congressional sanction. To get around this dilemma the committee offered to build the vessel at its own expense and risk provided the Government would accept and pay for her as soon as her utility had been shown. It was estimated that she would cost about three hundred and twenty thousand dollars, and the readiness of the citizens to advance this amount of money under the circumstances shows what faith they had in Fulton's ability to produce the ship he promised.

The necessary recommendation was made to Congress and the bill for the construction of one or more floating batteries was passed in March,



Launch of the Fulton the First, 1814.

1814. A sub-committee of five from the Committee on Coast and Harbor Defence was appointed to take charge of the work, and Mr. Fulton was named as engineer and constructor. The committee consisted of General Dearborn, Colonel Henry Rutgers, Oliver Wolcott, Samuel L. Mitchell, and Thomas Morris, and on the twentieth of the following June they were present at the laying of the keel of the first steam frigate that was ever built.

Originally she was called the Demologos but was subsequently named Fulton the First.

On the 29th of October, little more than four months from the date of placing the first timber in position, the ship was launched from the yard of Adam and Noah Brown on the East River. There was an immense crowd in attendance, many ships of war and merchantmen were anchored in the harbor, and all the steamboats of which New York could then boast were present with their decks covered with spectators. The vessel slid easily into the water, and the launch was successfully accomplished without accident.

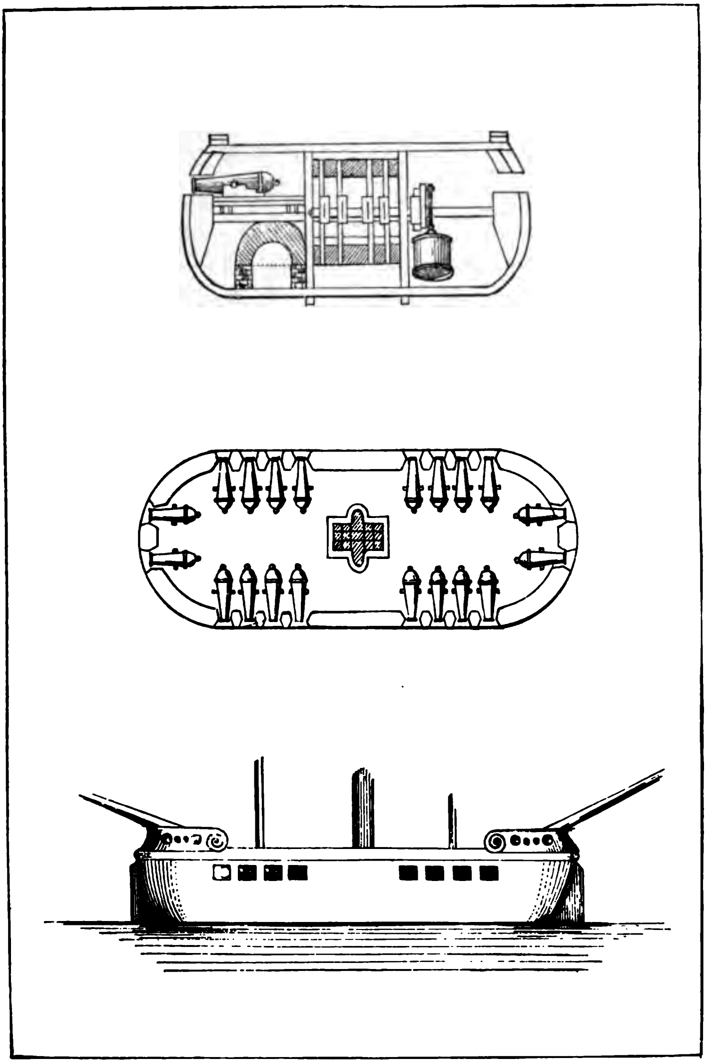
The rapidity with which the work was performed is proof of the energy of Mr. Fulton who was at the same time superintending the manufacture of the engines of the ship at one of the largest foundries in the city. It must be remembered that nothing of the kind had ever been done before, and the inventor had much difficulty in making the workmen understand his plans. Many times the work was done incorrectly and had to be thrown away, and the vexation and annoyance were enough to turn the sweetest temper to vinegar. After the vessel was launched there were many delays about the machinery, and Mr. Fulton spent much of his time at the foundry in superintendence of the work

In January, 1815, he was called to Trenton, New Jersey, as a witness in the case of John R. Living ton. The Legislature of that State had passed a law which prohibited any steamboats not belonging to the licensees under the monopoly of John Fitch from carrying passengers to or from any part of New Jersey; Fitch's license was granted in 1787 for thirteen years on certain conditions. These conditions had never been met, and furthermore the license had long since terminated by limitation, but an enterprising speculator bought it for ten dollars, and persuaded the wise men of the Legislature to revive it. John R. Livingston owned the steamboat which had been running between New York and New Jersey, and it was stopped by the passage of the law. He had petitioned for the repeal of the unjust enactment, and Mr. Fulton was called to show the facts in the case; after hearing him and other witnesses the legislators rescinded the oppressive law.

The weather was very severe, and Mr. Fulton was much exposed and chilled through while waiting in the hall of the State capitol. In crossing the Hudson on his return to New York his boat was caught in the ice and detained several hours, while a gale was blowing from the north. The chill caught at Trenton was increased by this exposure, and on reaching his house Fulton was confined to his bed for several days. He was very anxious about the progress on the steam frigate, and before able safely to do so he went again to the foundry and to the docks where the ship was lying. Additional exposure sent him to his bed again, from which he never rose. He died on the 24th of February, 1815, in the fiftieth year of his life.

Work on the war steamer was delayed but not stopped by Mr. Fulton's death. The war was over, and the immediate necessity for the ship had disappeared, so that she was not hurried to completion. There was some difficulty in raising the necessary funds for the work, as the citizens who were zealous for the ship while the war lasted had become indifferent after the restoration of peace. The contractors were required to wait some time for their pay, and the wages of the workmen fell in arrears. Once the men refused to work longer unless they received what was due them. In the language of modern days, they "struck," and the committee was obliged to advance the money needed for the wages account.

Cannon for the armament were not on hand in New York, or rather could not be spared from the ships and forts defending the harbor, and it was decided to use British cannon from a prize that had been taken into Philadelphia. To avoid the risk of recapture by the British cruisers along the coast, the cannon were brought overland from Philadelphia to New York at a time when the roads of New Jersey were especially difficult on account of



The "Fulton the First" (from drawings by Mr. Fulton).

the mud. Altogether, the first war steamer of the world was constructed under adverse circumstances.

During the month of May her engines were placed on board, and on the first day of June, 1815, she made a short trial trip in the harbor. She fully met the expectations of her builders, as she went directly in face of wind and tide, crossed the currents and eddies without difficulty, and was easily steered among vessels at anchor in spite of the high wind and rough waves that prevailed on that day. Several defects in her construction and in the arrangement and working of the machinery were discovered, and the commissioners immediately set about their correction.

Of her subsequent performances and her description, we have the following narrative by Mr. Colden in his memoir of Fulton:

"On the fourth of July, in the same year, the steam frigate made a passage to the ocean and back, and went the distance, which, going and returning, is fifty-three miles, in eight hours and twenty minutes, by the mere force of her engine. These trials suggested the correction of some errors, and the supplying of some defects in the machinery. In September, she made another passage to the sea, and having at this time the weight of her whole armament on board, she went at an average of five and a half miles an hour, with and against the tide. When stemming the tide, which ran at the rate of three miles an hour, she advanced at the rate of two and a half miles an hour, "This performance was not more than equal to Mr. Fulton's expectations; but it exceeded what he had promised the Government, which was, that she should be propelled by steam, at the rate of from three to four miles an hour.

"The substance of the following description of the 'Fulton the First,' the honored name this vessel bears, is extracted from the report of the gentlemen who were the commissioners for building her.

"She is a structure resting on two boats and keels, separated from end to end by a channel fifteen feet wide, and sixty-six feet long; one boat contains the caldrons of copper to prepare her steam. The cylinder of iron, its piston, levers, and wheels occupy part of the other. The water-wheel revolves in the space between them. The main or gun deck supports the armament, and is protected by a parapet, four feet ten inches thick, of solid timber, pierced by embrasures. Through thirty port-holes, as many thirty-two pounders are intended to fire red-hot shot, which can be heated with great safety and convenience. Her upper or spar-deck, upon which several thousand men might parade, is encompassed with a bulwark, which affords safe quarters; she is rigged with two stout masts, each of which supports a large latteen yard and sails; she has two bow-sprits and jibs, and four rudders, one at each extremity of each boat; so that she can be steered from either end foremost; her machinery is calculated for the addition of an engine, which will discharge an immense column of water, which it is intended to throw upon the deck, and through the port-holes of an enemy, and thereby deluge her armament and ammunition. If, in addition to all this, we suppose her to be finished, according to Mr. Fulton's intention, with hundred-pound columbiads, two suspended from each bow, so as to discharge a ball of that size into an enemy's ship at ten or twelve feet below her water-line; it must be allowed that she has the appearance at least of being the most formidable engine for warfare that human ingenuity has contrived.

"The English were not uninformed as to these preparations which were making for them, nor inattentive to their progress. It is certain that the steam frigate lost none of her terrors in the reports, or imaginations of the enemy. In a treatise on steam vessels, published in Scotland, the author says he has taken great care to procure full and accurate information about a steam frigate said to have been launched in New York, which he describes in the following words: 'Length on deck, three hundred feet; breadth, two hundred feet; thickness of her sides, thirteen feet, of alternate oak plank and cork-wood; carries forty-four guns, four of which are hundred pounders; quarter-deck and forecastle guns, forty-four pounders; and further, to annoy an enemy attempting to board, can discharge one hundred gallons of boiling water in a minute, and by mechanism, brandishes three hundred cutlasses with the utmost regularity over her gunwales; works also an equal number of heavy iron spikes of great length, darting them from her sides, with prodigious force, and withdrawing them every quarter of a minute.'"

The war was over before the "Fulton the First" was ready for battle, or in a condition to be made ready in a short time, and there was no opportunity of testing her qualities. She was taken to the Navy Yard at Brooklyn, where she was moored near the shore, and for more than ten years was used as a receiving ship. On the fourth day of

June, 1829, she was blown up by the explosion of two and a half barrels of gunpowder in her magazine. Her timbers were a good deal rotted, and she went to pieces so badly after the explosion that all thought of repairing her was out of the question.

Whether the accident was intended or accidental has never been clearly ascertained. Twenty-four men and one woman were killed, and five others were missing and supposed to have been killed. Nineteen men were wounded, most of them severely, and from the numbers on board at the time, it was a wonder that the casualties were so few. Commodore Chauncy, in reporting the loss to the Government, said: "The explosion could not have taken place by accident, as the magazine was as well or better secured than the magazines of other ships"; but at the same time he "cannot assign a motive to those in the magazine for so horrible an act as to voluntarily destroy themselves and those on board."

Another officer who was attached to the Fulton at the time of her destruction wrote long afterwards that her magazine, if it could be called one, was nearly under the ship's coppers, and close to the "bag-room," where the sergeant of marines had a writing-desk, which was lighted by a naked oil-lamp. "Soon after joining the ship," he says, "I had occasion to go down there; the bulkhead had a sliding-door, which was open, and the sergeant's lamp shone on the kegs of powder, one of which was without a head. I remarked to the sergeant: 'if your light was only five feet nearer (all the space that separated it from the powder) there would be trouble.' 'Yis,' said he, turning his beery eyes on me, 'there would be a sensation.' After that I never turned in at night without thinking there might be a sensation before morning, and to this day I have not forgotten the appearance of that powder, with the light shining on it, and draw the inference that gross carelessness caused the sensation. There was a story at that time that a gunner's mate had been disrated and punished with the cats the morning before the blowing up of the Fulton."

Five years after the launch and trial of the "Fulton the First" at New York, the English Government decided to build three steam gunboats, the first steam vessels that ever appeared in the British navy. They were the "Comet," "Lightning," and "Meteor," the "Comet" being the first to take the water and fly the naval ensign.

The three surveyors then in the admiralty refused to take the responsibility of constructing steam-vessels for sea service, and the work was performed by Oliver Lang, who was then an assistant surveyor of the navy. They were paddle steamers, 115 to 126 feet long, from 80 to 100 horse-power, and each carried three guns. The keels were laid in 1820, and the boats were not ready for sea until 1823.

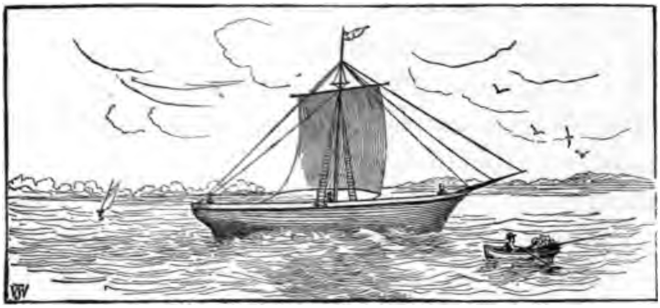
CHAPTER VIII.

Fulton's plan for a submarine boat—Description of "The Mute"—Fulton's last illness; his death and funeral—Fulton's family and estate—The ingratitude of republics—Tardy and niggardly action of Congress—Fulton and the "perpetual-motion" machine—Fulton's personal appearance and peculiarities—His grave in Trinity churchyard.

STILL another vessel for purposes of war was in the mind of Fulton at the time of his death, and actually under construction. It was a modification of his submarine boat, the Nautilus, and had a system of air-chambers by which it could be floated at varying depths at the pleasure of its commander, but was never to be entirely submerged. Fulton sent a model of this ship to the Government, which was approved, and the President authorized him to proceed with the construction. Fulton died before the hull of the craft was completed, and, as the workmen were unable to go on without him, operations upon it were suspended and never resumed.

This novel war-ship is thus described:

"Her sides were to be of the ordinary thickness, but her deck was to be stout, and plated with iron, so as to render it ball-proof, which would not require so much strength as might be at first imagined; because, as no shot could strike it from a vessel but at a very great angle, the ball would *ricochet* on a slight resistance from a hard substance. She was to be capable of sheltering a hundred men under her deck, and was to be moved by a wheel placed in another air-chamber near the stern, so that, when the vessel was to be propelled, only a part of the under paddles should be in water, at least the upper half of the wheel or more moving in air. The wheel was to be turned by a crank attached to a shaft that should penetrate the stern to the air-chamber through a stuffing-box and run along the middle of the boat until it ap-



Fulton's Nautilus.

proached her bows. Through this shaft rungs were to be passed, of which the crew were to take hold as they were seated on each side of it on benches. By merely pushing the shaft backward and forward the water-wheel would be turned and the boat be propelled with a velocity equal to the force of a hundred men. By means of the air-chamber she was to be kept, when not in hostile action, upon the surface, as common boats are. But when in reach of an enemy she was to sink so that nothing but her deck would be exposed to his view or to his fire. Her motion when in this situation would be perfectly silent, and therefore he called this contrivance "The Mute." His design was that she should approach an enemy, which he supposed she might do in fogs or in the night, without being heard or discovered, and do execution by means of torpedoes or submarine guns." *

The Mute was provided with mast and sails ; the sails could be lowered and the mast struck whenever it was necessary to bring them down, but in ordinary times she would present the appearance

The Mute.

of a common sailing craft and be moved in the same way. Several inventors of later days have devised boats not much unlike the Mute, and some of them have done effective work.

Fulton's illness was not considered dangerous until a very short time before his death, and consequently the news of that event came like a shock to the public. The newspapers that announced it were dressed in mourning, the corporation of the

* See illustration of "The Mute" in Chapter III.

city and several literary and scientific societies held special meetings and passed resolutions eulogistic of Mr. Fulton and expressing their deep grief at his demise. Some of the societies appointed delegations to be present at the funeral, while others voted to attend in a body. The Legislature was then in session at Albany, and as soon as the sad news was received appropriate resolutions were passed, and it was voted that the members should wear mourning badges for a designated time.

Mr. Fulton's last residence was at No. 1 State Street, and the funeral cortege from the house to Trinity Church was one of the most imposing that had ever been seen in New York up to that date. The funeral was attended by all the officers of the State and National Governments then in the city, by the mayor and common council, by the societies already mentioned, and by many prominent citizens who came to testify their appreciation of the man and the inventor.

While the procession was moving from State Street to Trinity Church minute guns were fired from the Battery and the flags on ships in the harbor were at half-mast. The body was placed in a vault belonging to the Livingston family. The remains were enclosed in a leaden coffin covered with one of mahogany, and when the vault was last opened a few years ago the casket was found in a good state of preservation.

Fulton left a widow and three children, one son and two daughters; he had been married but nine years, and his widow died a few years after the loss of her husband. The son, Robert Barlow Fulton, died in 1841; the daughters were married, one in Philadelphia and the others in New York, and lived to or beyond middle life. Mr. Fulton's will was made about two months before his death; it left nine thousand dollars a year to his wife during her lifetime, and made suitable provision for the education and maintenance of his children out of the residue of his estate. There were bequests to his brother and sisters and to their children. In the event of the death of all his children before the death of his wife and without issue he devised half of his property not otherwise disposed of for "the promotion of an academy of fine arts, for historical and scientific paintings, which academy shall be established at the seat of government of the United States."

As before stated he had spent about five thousand dollars for the publication of Joel Barlow's "Columbiad"; this expenditure gave him a property interest in the work, which he relinquished to Mr. Barlow's widow, with the exception of fifty copies of the book. He also willed that the money then due him from the estate of Joel Barlow—about seven thousand dollars—was not to be demanded from Mrs. Barlow in her lifetime, but should be the legal claim of his estate after that lady's death.

The will was proved and entered upon the records of the surrogate's office February 27th, 1815. The terms of the will show that Fulton expected his estate to be of considerable value, as he devises that the sums mentioned therein shall be paid "out of the profits arising from my steamboats, and in case of that not proving sufficient, then out of any other property or profits arising from my real or personal." Like most inventors Fulton was sanguine as to the success of his inventions and the large amounts of money that would be received from them.

Though theoretically possessing a fortune, Fulton really died penniless in consequence of the numerous lawsuits with which he was harassed, and the opposition that had followed the successful establishment of the Clermont and her sister boats on the Hudson. Envy and greed robbed him of what was his proper due, and he never received a cent for his patents. Neither Fulton nor Livingston, the pioneers of steam navigation, ever realized from their work as much as they invested in it, and the inventor left an estate burdened with debt. Fulton was in the service of the United States at the time of his death, as he was supervising the construction of the steam frigate, and the government was indebted to him upwards of one hundred thousand dollars for money expended on its account in accordance with his contracts, and his claim for the services of the Vesuvius at New Orleans.

Twenty years after his death a bill for the relief of his heirs was introduced in Congress, but it did not become a law until 1846, when Fulton had been thirty-one years in his grave. No allowance was made for interest, and the amount was reduced to $76,300 before the passage of the bill. That republics are ungrateful is well shown by the history of Fulton's claim for compensation. The steamboat has been one of the most important agencies in the development and growth of the country, second only to the railway, and by many claimed to be its superior, but the Government refused to pay the just claims of Fulton for money expended, and granted no recognition whatever for the great services he performed in the interest of commerce and civilization.

Mr. Colden tells the following story to illustrate Fulton's quickness in grasping ideas relating to machinery :

"It is well known how long and how successfully Redheffer had deluded the Pennsylvanians by his perpetual motion.

"Many men of ingenuity, learning, and science had seen the machine. Some had written on the subject—not a few of these were his zealous advocates,—and others, though they were afraid to admit that he had made a discovery which violated what were believed to be the established laws of nature, appeared also afraid to deny what the incessant motion of his wheels and weights seemed to prove. These contrived ingenious theories which were hardly less wonderful than the perpetual motion itself. They proposed that Redheffer had discovered a means of developing gradually some hidden power, which, though it could not give motion to his machine forever, would keep it going for some time, which they could not pretend to determine.

"One of these perpetual motions commenced its career in New York City in 1813. Mr. Fulton was a perfect unbeliever in Redheffer's discovery, and, although hundreds were daily paying their dollar to see the wonder, Mr. Fulton could not be prevailed upon to follow the crowd. After a few days, however, he was induced by some of his friends to visit the machine. It was in an isolated house in the suburbs of the city.

"In a very short time after Mr. Fulton had entered the room in which it was exhibited, he exclaimed: 'Why, this is a crank motion.' His ear enabled him to distinguish that the machine was moved by a crank, which always gives an unequal power, and, therefore, an unequal velocity in the course of each revolution, and a nice and practised ear may perceive that the sound is not uniform. If the machine had been kept in motion by what was its ostensible moving power, it must have had an equable rotary motion, and the sound would have been always the same.

"After some little conversation with the showman, Mr. Fulton did not hesitate to declare that the machine was an imposition, and to tell the gentleman that he was an impostor.

"Notwithstanding the bluster and anger which these charges excited, he assured the company that the thing was a cheat, and that, if they would support him in the attempt, he would detect it at the risk of paying any penalty if he failed.

"Having obtained the assent of all who were present, he began by knocking away some very thin little pieces of lath, which appeared to be no part of the machinery, but to go from the frame of the machine to the wall of the room, merely to keep the corner-posts of the machine steady.

"It was found that a catgut string was led through one of these laths and the frame of the machine to the head of the upright shaft of the principal wheel; that the catgut was conducted through the wall and along the floors of the second story to a back cockloft at the distance of a number of yards from the room which contained the machine, and there was found the moving power. This was a poor old man with an immense beard, and all the appearance of having suffered a long imprisonment; who, when they broke in upon him, was unconscious of what had happened below, and who, while he was seated on a stool gnawing a crust, was with one hand turning a crank.

"The proprietor of the perpetual motion soon disappeared. The mob demolished his machine—the destruction of which immediately put a stop to that which had been, for so long a time and to so much profit, exhibited in Philadelphia."

Fulton was of slender but well-proportioned figure, and about six feet high, he had strong features, an abundance of dark, curly hair, and his forehead was high and projecting. His eyes were large and dark, and are said to have been expressive to an unusual degree. His personal characteristics are thus given by his friend Colden :

" Nature had made him a gentleman and bestowed upon him ease and gracefulness. He had too much good sense for the least affectation, and a modest confidence in his own worth and talents gave him an unembarrassed deportment in all companies. His temper was mild and his disposition lively ; he was fond of society, which he always enlivened by cheerful, cordial manners and instructed or pleased by his sensible conversation. He expressed himself with energy, fluency, and correctness, and as he owed more to his own experience and reflections than to books, his sentiments were often interesting from their originality.

" In all his domestic and social relations he was zealous, kind, generous, liberal, and affectionate. He knew of no use for money but as it was subservient to charity, hospitality, and the sciences. But what was most conspicuous in his character was his calm constancy, his industry, and that indefatigable patience and perseverance which always enabled him to overcome difficulties.

" He was decidedly a Republican. The determination which he often avowed, that he would never accept an office, is an evidence of the disinterestedness of his politics, but his zeal for his opinions or party did not extinguish his kindness for the merits of his opponents. Society," says Mr. Colden in conclusion, " will long remember and regret him, but he will be most lamented by those by whom he was best known."

To show the estimation in which he was publicly held, the following words of two distinguished citizens of New York are herewith presented:

Extract from a discourse delivered before the American Academy of the Arts, by his Excellency, DeWitt Clinton, Governor of New York.

* * * * * * *

"Fortunately for the interests of mankind, Mr. Livingston became acquainted with ROBERT FULTON, a self-created man, who has risen into distinguished usefulness and into exalted eminence by the energies of his own genius unsupported by extrinsic advantages.

"Mr. Fulton had directed the whole force of his mind to mathematical learning and mechanical philosophy. Plans of defence against maritime invasion and of subaquatic navigation had occupied his reflections. During the late war he was the Archimedes of his country.

"The poet was considered under the influence of a disordered imagination when he exclaimed:

> "'Soon shall thy arm, unconquer'd steam, afar
> Drag the slow barge, or drive the rapid car;
> Or on wide-waving wings expanded bear
> The flying chariot through the fields of air!'

"The connection between Livingston and Fulton realized to a great degree the vision of the poet. All former experiments had failed, and the genius of Fulton, aided and fostered by public spirit and discernment of Livingston, created one of the greatest accommodations for the benefit of mankind. These illustrious men will be considered through all time as the benefactors of the world; they will be emphatically hailed as the Castor and Pollux of antiquity—*lucida sidera*—stars of excellent light and the most benign influence.

"Mr. Fulton was personally well known to most who hear me. To those who were favored with the high communion of his superior mind, I need not expatiate on the wonderful vivacity, activity, comprehension, and clearness of his intellectual faculties; and while he was meditating plans of mighty import for his future fame and his country's good, he was cut down in the prime of his life, and in the midst of his usefulness. Like the self-burning tree of Gambia, he was destroyed by the fire of his own genius, and the never-ceasing activity of a vigorous mind."

Extract from a discourse delivered before the New York Historical Society, in September, 1816, by the Hon. Gouverneur Morris.

* * * * * * *

"If the learned leisure of European wealth can gain applause or emolument for meting out, by syllables reluctantly drawn together, unharmonious hexameters, far be it from us to rival the manufacture. Be it ours to boast that the first vessel successfully propelled by steam was launched on the bosom of Hudson's River. It was here that American genius, seizing the arm of European science, bent to the purpose of our favorite parent art the wildest and most devouring element.

"The patron, the inventor, are no more. But the names of Livingston and of Fulton, dear to fame, shall be engraven ON A MONUMENT SACRED TO THE BENEFACTORS OF MANKIND. There generations yet unborn shall read:

" 'Godfrey taught seamen to interrogate
With steady gaze, though tempest-tossed, the sun,
And from his beam true oracle obtain.
Franklin dread thunderbolts, with daring hand,

Seized and averted their destructive stroke,
From the protected dwellings of mankind.
FULTON by flame compelled the angry sea,
To vapor rarefied, his bark to drive,
IN TRIUMPH proud, thro' the loud-sounding surge.'

"This invention is spreading fast in the civilized world; and though excluded as yet from Russia, will, erelong, be extended to that vast empire. A bird hatched on the Hudson will soon people the floods of the Volga, and cygnets descended from an American swan glide along the surface of the Caspian Sea. Then the hoary genius of Asia, high-throned on the peaks of Caucasus, his moist eye glistening while it glances over the ruins of Babylon, Persepolis, Jerusalem, and Palmyra, shall bow with grateful reverence to the inventive spirit of this Western world.

"Hail, Columbia! child of science, parent of useful arts—dear country, hail! Be it thine to meliorate the condition of man. Too many thrones have been reared by arms, cemented by blood, and reduced again to dust by the sanguinary conflict of arms. Let mankind enjoy at last the consolatory spectacle of thy throne, built by industry on the basis of peace, and sheltered under the wings of justice. May it be secured by a pious obedience to that Divine Will which prescribes the moral orbit of empire with the same precision that his wisdom and power have displayed in whirling millions of planets round millions of suns through the vastness of infinite space."

While preparing this volume the author visited Trinity churchyard, in order to see the grave of Robert Fulton. Without making known his purpose he asked for the Livingston vault, and was directed to a plain slab of brown sandstone, about two feet by three, set on a level with the grass around it, near the rear of the church. On the surface of the slab is inscribed the following:

"The vault of Walter and Robert C. Livingston, sons of Robert Livingston, of the manor of Livingston."

"This is the Livingston vault," said the attendant. "Robert Fulton is buried there too; he was a great friend of the Livingstons, and was married in the family, and he made the first steamboat on the North River."

Fulton's name is not upon the slab, nor is there any monument near the spot to show that his remains are here. The stranger in search of Fulton's grave, and unacquainted with the circumstances of his burial, could not find the spot unless directed to it as was the writer of these words. The grave of the builder of the first successful passenger steamboat and of the first steamship of war that was ever launched, is unmarked by a monument or even by a stone of any kind bearing his name! How prophetic were the words of Emmet as he addressed Mr. Fulton while pleading his case before the Legislature of the State of New York:

"Yes, my friend; my heart bleeds while I utter it; but I have fearful forebodings that you may hereafter find in public faith a broken staff for your support, and receive from public gratitude a broken heart for your reward."

The grave is but a few yards from the Elevated Railway, where every day pass hundreds of trains bearing thousands of passengers in their journeys between the business and residence portions of New York. How many of these thousands know where Fulton is buried? Could not the Trinity corporation spare from its vast accumulation of wealth sufficient money to pay the cost of a plain shaft bearing the words "Robert Fulton"? Such a monument need not be costly, and the justice and propriety of its erection no man will deny.

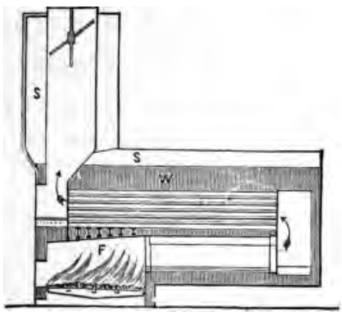
CHAPTER IX.

First ocean voyage of a steamer—The Stevens family and their work in steam navigation—The Stevens Battery—Commodore Vanderbilt—His opposition boats and his steamship enterprises—The Chancellor Livingston—Modern steamboats on the Hudson—Incidents and anecdotes of steamboating—The fastest boats.

WE have seen how steamboats were successfully established on the Hudson River and on Long Island Sound, and have also learned something of their first appearance in the valleys of the Ohio and Mississippi. The first ocean voyage of a steamer was made from New York to Philadelphia in the summer of 1808. It was performed by the steamboat Phœnix, built by Col. John Stevens at Hoboken. The Phœnix was originally intended for the navigation of the Hudson, but in consequence of the monopoly of Fulton and Livingston in New York waters, Col. Stevens decided to take his boat around to the Delaware River, where she ran successfully for several years.

Other boats were built by Col. Stevens and his sons, not only for the Delaware River, but for the Connecticut, and later on for the Hudson and other waters contiguous to New York.

Colonel John Stevens was born in New York in 1749, and died in Hoboken in 1838. Towards the end of the last century he turned his attention to the availability of the steam-engine for propelling boats, and in 1791 made his first experiment. It has been claimed that he invented the tubular boiler about 1803 or 1804. Admirable Preble says a patent for that invention was taken out by Nathan Reed in 1790. As early as 1789, Stevens



Stevens' Return Tubular Boiler.

sent a memorial to the Legislature, in which he claimed to have solved the problem of steam navigation. But he does not seem to have given it especial attention for several years after that time. Before Chancellor Livingston went to France, he had several conferences with Col. Stevens on the subject of steam navigation, but nothing of consequence came from their relations.

As before stated, Stevens' first steamboat was launched in 1804, and easily crossed the Hudson from Hoboken to New York. He used for this experiment a rotary engine, but its operations were unsatisfactory, and he removed it to make place for one of Watts' engines. The boilers were tubular, and said to have been the first constructed on that principle. The machinery was made by Col. Stevens at his shop in Hoboken, and was somewhat complicated; it communicated motion to the twin screws which propelled the craft, and which had been made with a great deal of trouble, under the directions of the designer of the apparatus.

His second steamboat, the Phœnix, was the one which made the first sea voyage ever performed by a steam-vessel. The Phœnix, on this memorable occasion, was commanded by Capt. De Graw, and her engines were in charge of Robert Livingston Stevens, a son of Col. John Stevens; he was then only twenty years of age, but had already distinguished himself for his mechanical and technical ability. The steamer was accompanied by a schooner as a matter of precaution, in case of accident. A storm arose, and the schooner was driven to sea, and did not return for several days; but the Phœnix put into Barnegat, where she remained till the storm was over, when she continued her voyage around Cape May to Philadelphia.

For many years the Phœnix ran between Philadelphia and Trenton, New Jersey, forming one of the Swift-sure Line, connecting Philadelphia and

New York by means of steamboats and stages. A description in a newspaper of the time says she had no wheel-house, and sometimes, when the wind was high, the water would be thrown as high as her smoke-stack. Previous to her departure a tin horn was blown, and there was always a crowd at the wharf in Philadelphia to see her off. Her engines were high-pressure condensing and her boilers sectional.

Engine, Boiler, and Screw Propellers used by Stevens, 1804.

Robert L. Stevens is thus mentioned by Scott Russell:

"He is probably the man to whom, of all others, America owes the greatest share of its present highly improved steam navigation. His father was associated with Livingston in his experiments previous to the connection of the latter with Fulton, and persevered in his experiments during Livingston's absence in France. Undisputably he is the pioneer of steam navigation on the open sea."

During the War of 1812, he invented and sold to the Government an elongated shell, which was intended to explode by percussion after being fired from a smooth-bore gun, and in 1816 he began running a steam ferry-boat between Hoboken and New York. The Clermont and her successors for several years burned wood for fuel; in 1818, Mr. Stevens constructed furnaces for burning anthracite coal, and used it successfully on his boats, but it did not come into extensive use for purposes of navigation until after 1830. Previous to its introduction, the great space required for wood had materially limited the room for freight and passengers. Some authorities say the earning power of a steamboat was increased not less than twenty per cent. when coal took the place of wood, while the danger from fire was diminished.

Other improvements in steamboats are credited to this gentleman. In 1821, he replaced the heavy working-beam of cast iron with a much lighter and smaller one of wrought iron; three years later, he supplied an artificial blast to the furnaces; and from that time until his death, in 1856, his mind was constantly employed with the development of steam for purposes of navigation.

In 1842 he laid before the Government a plan for defending the forts and harbors of the United States with floating steam batteries; his plans were favorably received, and he was authorized to go on with the work, which was not begun until some years later. His design was for a screw steamer, 420 feet long, 52 feet breadth, and a depth of 28 feet. Her sides and deck were plated with iron varying from three to six and a half inches in thickness, and the sides were at an angle that was intended to cause projectiles to glance off on striking it. In ordinary trim, and with coal and stores on board, the ship had a draft of twenty feet, six inches ; when in action, she was to take water into certain compartments prepared for it, so that she would sink two feet, thus making her fighting draft twenty-two feet, six inches. Her guns were arranged so that they could be worked by steam, and the men working them were protected by shot-proof armor.

The Stevens battery was incomplete at the time of the inventor's death. His brother, Edwin Augustus Stevens (born 1795), spent a large sum of money upon her, and at his death, in 1868, left one million dollars by his will for her completion. This amount was insufficient, and the vessel was sold in 1874 to the United States Government by the State of New Jersey, to which it had been bequeathed by Mr. Stevens. Congress did not see fit to appropriate the money to pay for her, and she was finally sold at auction and broken up for her materials and machinery. To Mr. E. A. Stevens the city of Hoboken and the country at large are indebted for the Stevens Institute of Technology, an educational establishment of no small importance.

Cornelius Vanderbilt, better known as the "Commodore," was an energetic opponent of the enterprise of Fulton and Livingston ; he had no respect for a monopoly in which he was not interested, and throughout his life his energies were largely devoted to breaking up the enterprises of other people, in order to make them his own. He was born in 1796; at sixteen years of age he was the owner of a sail-boat, which he ran as a ferry between New York and Staten Island, and when eighteen years old, he owned two sail-boats, and was doing a profitable business with them. In 1817 he joined Thomas Gibbons in building a steamboat, to run between New York and New Brunswick, New Jersey; he was captain of the boat at a salary of one thousand dollars a year, and in the following year he built and commanded a larger and better boat for the same line. In a few years he became full manager of the Gibbons Line, and by 1824 it was paying an annual profit of forty thousand dollars. In 1827 he took a long lease of the ferry between New York and Elizabethport, New Jersey, which he made very profitable, and in 1829 he began running boats on the Hudson and Delaware rivers, and on the route to Boston by way of Long Island Sound.

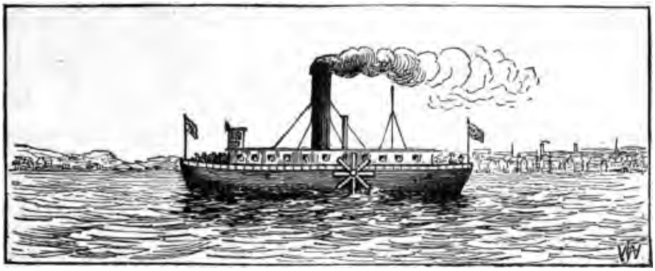
Commodore Vanderbilt's policy was to compete with existing lines by building better and faster boats than they had, and running them at lower rates. Frequently passengers were carried for nothing, and sometimes competition was so fierce that meals and lodgings were included in free tickets. He generally continued the opposition until his competitors abandoned the route and allowed him to establish a monopoly of his own, when the prices where immediately advanced to figures that paid a handsome profit. Sometimes he was bought off and induced to retire, but he invariably made money by the retirement; in such cases the old companies did not long remain the sole possessors of the field, as a new opposition would be organized with very little delay. In the nineteen years between 1829 and 1848 he owned and operated nearly fifty steamboats, of which the larger number were built by him, and though often running them at heavy losses the aggregate of business gave him handsome profits.

The discovery of gold in California in 1848 turned his attention to ocean navigation. In 1848–9 he built the steamship Prometheus and in 1850 he sailed in her for the Isthmus of Darien with the intention of establishing a route to California; he had secured a controlling interest in the "American Atlantic and Pacific Canal Company," but an examination of the route decided him to establish a transit across Nicaragua from Greytown on the Atlantic side to San Juan del Sur on the Pacific. In 1851 he placed three steamers on the Atlantic side of the line, and four on the Pacific, and began an active competition with the "United States" and "Pacific Mail" companies which were running by way of Chagres, or Aspinwall, and Panama.

Later he ran an opposition line over the entire route covered by these companies and was finally bought off by the payment of a large subsidy, as there was not sufficient business to enable all the lines to be profitably operated. In 1855 he established a transatlantic line, which was discontinued in 1861, when he gave his finest steamer, the Vanderbilt, to the Government to be used for war purposes. While engaged in ocean navigation he built eleven steamships and was the owner of ten others, or twenty-one in all. Commodore Vanderbilt's connection with steam vessels of all kinds covered a period of forty-seven years and at his retirement from the water he was said to have accumulated a fortune of forty millions of dollars.

As the Chancellor Livingston was the last of the steamboats planned by Fulton, her description and history deserve a place in this memorial.

Her keel was one hundred and fifty-four feet long, and her decks one hundred and sixty-five feet; she was thirty-two feet wide and drew seven feet three inches of water when loaded. Her main cabin was fifty-four feet long and had thirty-eight sleeping berths; above this there was a ladies' cabin thirty-six feet long with twenty-four berths, and there was a forward cabin thirty feet long with fifty-six berths. Then there were other berths in the captain's, engineer's, and pilot's cabins, and altogether there were sleeping accommodations on the Chancellor Livingston for one hundred and thirty-five persons. Her measurement was four hundred and ninety-six tons, which was one hundred and twenty-five tons larger than any of her predecessors on the Hudson. She had an engine of seventy-five horse power, with a cylinder forty-five inches in diameter and

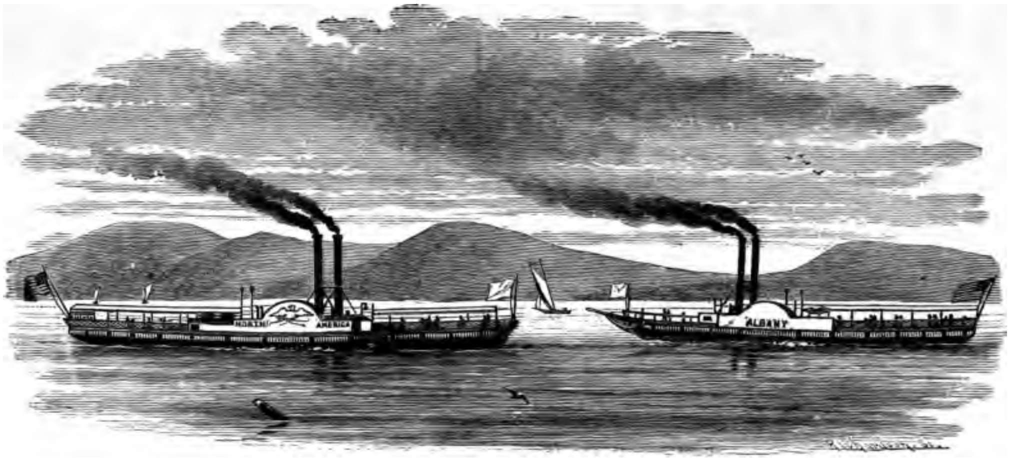


Chancellor Livingston, 1815.

seven feet stroke. Her boiler was twenty-eight feet long and twelve broad ; she had two funnels, and her wheels were seventeen feet in diameter, with paddle-boards five feet ten inches long. She had two fly-wheels, each 14 feet in diameter, connected by pinions to the crank-wheel. She made eight miles an hour on the average ; with strong wind and tide in her favor she made twelve miles an hour, but when they opposed her the speed was not more than six. She was afterwards lengthened and provided with a larger engine, which considerably increased her speed.

The Chancellor Livingston ran on the Hudson for nearly sixteen years. In 1832 she was bought by Cornelius Vanderbilt and Amos H. Cross, of Portland, and placed on the route between Boston and Portland as an opposition boat. Before going on that route she was provided with her third engine, which had a 56-inch cylinder and six feet stroke. After running there two years she was condemned as a sea-boat and broken up at Portland. Her engines were placed in a new boat called the Portland, which was launched in 1835, and took the place of the Livingston as a passenger boat. She was chartered to the Government during the Mexican war, and was finally lost on the coast of Mexico about the year 1848. She is said by some to have been the first boat on which anthracite coal was successfully burned, and the invention of the blower, by which this was accomplished, is credited to her engineer, afterwards captain, J. B. Coyle. This claim is stoutly opposed by supporters of Robert L. Stevens. They assert that the latter gentleman used it on the steamer Passaic in 1818, several years before Coyle thought of it.

When the Chancellor Livingston took her place on the New York and Albany route, there were many wise men who predicted her failure on ac-



The North America and Albany, 1827–1839.

count of her great size. It was thought she would be difficult to turn in the bends of the river and unable to avoid collisions with sailing and other craft, while her movements in coming to her dock at either end of the route would be so slow as to exhaust the patience of passengers. All these predictions proved without foundation, and the success of the large boat stimulated the building of larger ones. The reader will bear in mind that while the Livingston was of greater tonnage than any of the other boats constructed by Fulton, she was not as long as either the Car of Neptune or the Paragon, which were 175 and 173 feet respectively, while the Livingston was 165 feet. The superior tonnage was obtained by greater width of beam.

Compare the above lengths with those of the steamers that navigated the Hudson in 1838 and the few previous years, and see how the vessels grew in size as the business of steam navigation developed. The following are some of the figures —the name of each boat being followed by its length in feet:

De Witt Clinton, 230; North America, 212; Swallow, 233; Albany, 212; Rochester and Utica, 200 each.

In 1854 boats of the following lengths were running on the Hudson and contiguous waters:

Isaac Newton, 333; Bay State, 300; Empire State, 304; Oregon, 375; Hendrick Hudson, 320;

C. Vanderbilt and Connecticut, 300 each; New World, 376; Alida, 286.

In 1830 there were eighty-six steamboats running on the Hudson River and contiguous waters.

The following description of the boats on the Hudson was written by Dr. Lardner in 1854. Little changes would be needed to adapt it to the present time. Although more than thirty years have passed since it was penned, electric bells have taken the place of the old-fashioned mode of signalling to the engineer, electric lights have been introduced in place of oil or gas for illuminating purposes, some of the boats are larger and their cabins are more spacious and more profusely upholstered, but in nearly all particulars the conditions are the same. The extract is from Dr. Lardner's "Museum of Science and Arts," volume ii.

"To obtain an adequate notion of the form and structure of one of the first-class steamboats on the Hudson, let it be supposed that a boat is constructed similar in form to a Thames wherry, but above three hundred feet long and twenty-five to thirty feet wide. Upon this let a platform of carpentry be laid, projecting several feet upon either side of the boat, and at the stem and stern. The appearance to the eye will then be that of an immense raft, from two hundred and fifty to three hundred and fifty feet long and some thirty or forty feet wide. Upon this flooring let us imagine an oblong rectangular wooden erection, two stories high, to be raised. In the lower part of the boat and under the flooring, a long narrow room is constructed, having a series of berths at either side, three or four tiers high. In the centre of this flooring, usually, but not always, is enclosed an oblong rectangular space, upon which the steam machinery is placed, and this enclosed space is continued upward through the structures raised in the platform, and is intersected at a certain height above the platform by the shaft or axle of the paddle-wheel.

"These wheels are propelled generally by a single engine, but occasionally by two. The paddle-wheels are of great diameter, varying from thirty to forty feet, according to the magnitude of the boats. In the wooden building raised upon the platform already mentioned, is a magnificent saloon, devoted to the ladies and those gentlemen who accompany them. Over this, in the upper story, is constructed a row of small bedrooms—state-rooms—each handsomely furnished, which passengers can have who desire seclusion, by paying a small additional fare. The lower apartment is commonly used as a dining- and breakfast-room.

"In some boats the wheels are propelled by two engines, which are placed on the platform which overhangs the boat at either side, each wheel being propelled by an independent engine; the wheels in this case acting independently of each other, and without a common shaft or axle. This leaves the entire space in the boat from stem to stern free of machinery. It is impossible to describe the magnificent *coup d'œil* which is presented by the immense apparent length when the communication between them is thrown open. Some of these boats are upwards of three hundred feet long, and the uninterrupted length of the saloons corresponds with this.

"This arrangement of machinery is attended with some practical advantages, one of which is a facility of turning, as the wheels acting independently of each other may be driven in opposite directions, one propelling forward and the other backward, so that the boat may be made to turn on its centre. Although, from the great width of the Hudson, no great difficulty is encountered in turning the longest boat, yet cases occur in which this power of revolution is found extremely advantageous. Another advantage of this system is that if one of the two engines becomes accidentally disabled, the boat can be propelled by the other.

"No spectacle can be more remarkable than that which the Hudson presents for several miles above New York. The skill with which these enormous vessels, measuring from three to four hundred feet in length, are made to thread their way through the crowd of shipping of every description moving over the face of this spacious river, and the rare occurrence of accidents, are truly admirable. In dark nights these boats run at the top of their speed through fleets of sailing vessels. The bells, through which the steersman speaks to the engineer, scarcely ever cease. Of these bells, there are several different tones, indicating the different operations which the engineer is commanded to make, such as stopping, starting, reversing, slackening, accelerating, etc. At the slightest tap of one of these bells, the enormous engines are stopped, or started, or reversed by the engineer, as though they were the playthings of a child. These vessels, proceeding at sixteen and eighteen miles an hour, are propelled among the crowded shipping with so much skill as almost to graze the sides, sterns, or bows of the vessels among which they pass.

"No spectacle," adds Dr. Lardner, "can be more remarkable than a large steam tow-boat dragging its enormous load up the Hudson. They may be seen in the middle of this vast stream surrounded by a cluster of twenty or thirty loaded craft of various magnitudes. Three or four tiers are lashed to each side, and as many more at the bow and at their stern. The steamer is almost lost to the eye in the midst of this crowd of vessels which cling around it, and the moving mass is seen to proceed up the river, no apparent agent of propulsion being visible. As this *water goods-train*, for so it may be called, ascends the Hudson, it drops off its load, vessel by vessel, at the towns which it passes. One or two are left at Newburgh, another at Poughkeepsie, two or three more at Hudson, one or two at Fishkill, and, in fine, the tug arrives with a residuum of some half a dozen vessels at Albany."

Steamboating on the Hudson may be said to have reached its height about the time the foregoing description was written. The Harlem Railway, connecting New York and Albany, became a competitor for the through business between the two cities, and the curious spectacle was offered of a war of rates, in which a ticket from one city to the other could be bought for a less price than for a point half way between them. At one time the fare from New York to Albany was advertised at one dollar, while a ticket to an intermediate point would cost twice or three times as much. Later, the Hudson River Railway, which winds along the eastern bank of the river and rarely leaves it more than a few yards away, was opened for business, and became a new competitor against the steamboats. There were times when the steamboats carried passengers for nothing, and the railway occasionally did likewise, but the free passage business was generally confined to the rivalries between different lines of steamboats.

Many and amusing are the stories told of the competitions between the boats on the great river of New York. The walls in the terminal cities, as well as those along the route, were covered with placards, in which the advantages of the boats were described in glowing terms, and along the streets and wharves in the vicinity of the landing-places there were leathern-lunged runners, who made the air resound with their appeals for patronage. A hesitating stranger ran the risk of being torn in twain by rival runners, and sometimes a traveller was dragged on board one boat, while his satchel was triumphantly transported to another.

One of the steamboat anecdotes relates to an old lady who was timid on the subject of boiler explosions. The rival runners sought to enlighten her by the most carnest assurances that there was not the least danger. One said the boilers of his boat had just been put in perfect repair, but the other man retorted that *his* boat had received entirely new boilers only the day before. Then the first man assured her that new boilers were at that moment being placed on board his craft, and the workmen would complete their task not more than five minutes before the time for starting.

The second runner saw his chance was diminishing, and appealed to one of his associates, who gravely assured the lady that his boat had no boilers whatever, but was run entirely by cold steam made from river water. "We took 'em all out last week," said he, "as we were determined to have a boat that would n't be able to blow up."

"Then I 'll go on your boat," said the lady, "as that 's just what I want. I 've always said they ought to make these pesky boats without boilers, and then they would n't be blowing folks up."

But if the boats carried passengers for nothing, they did not run entirely without remuneration. At such times they had crowds of passengers, as a matter of course, and they generally revenged themselves on the travelling public by charging high prices for what was sold on board. In some of the competitions meals were included in the free or cheap tickets, but this was not usually the case, and where they were not so included the boats often paid their running expenses by the profits of what they sold during their trips.

For the last thirty years the number of steamboats running on the Hudson has not varied greatly from year to year, or from one decade to another. But, while the number in use has remained practically unchanged, their size has increased. As the old boats have been withdrawn, new and larger ones have taken their places, and on the principal lines the traveller finds the maximum of speed and comfort with the minimum of expense.

The finest boats are on the lines to Troy and Albany, and during the summer season they are well patronized both by day and by night. The swiftest boat on the Hudson is the Mary Powell (at least such is the claim of her owners), which plies daily each way between New York and Poughkeepsie. She was built in 1861, and has been twice rebuilt since that time, her hull being entirely reconstructed, but her model remaining unchanged. Since her last reconstruction in 1881 she has made an average speed of twenty miles an hour, and during the month of June, 1882, she ran on one occasion at the rate of twenty-six miles an hour between Milton and Poughkeepsie, making the four miles of distance in nine minutes.

The steamer South America is reputed to have made twenty-six miles an hour on the Hudson River a year or two after she was launched. Other fast records of river steamers are:

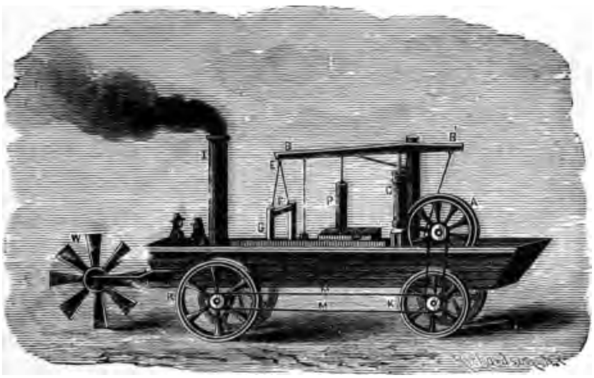
Mary Powell, 76 miles, New York to Poughkeepsie, in 3 h. 39 m. 30 sec., August 6, 1874; Chrysopolis, 125 miles, Sacramento to San Francisco, in 5 h. 18 m., on December 31, 1861; Alida, 145 miles, New York to Albany, 6 h. 21 m.; R. E. Lee, New Orleans to Natchez, 279 miles, 16 h. 36 m. 47 sec., on October 28, 1870; the same steamer, New Orleans to St. Louis, 3 days, 18 h. 14 m.

CHAPTER X.

The first steamboat on Western waters—Oliver Evans and his boat—Exploration of the Ohio and the Mississippi by Nicholas J. Roosevelt—Building the first steamboat at Pittsburgh—The pioneer voyage—Exciting adventures—Passing the falls of the Ohio—The comet and earthquakes of 1811—Indians—Arrival at New Orleans—A wedding at the end of the voyage.

WE will now turn to the valley of the Mississippi and study the history of steam navigation upon the "Father of Waters" and its tributaries. In 1802 Oliver Evans agreed with James M'Keever, of Kentucky, to build a steamboat to run on the Mississippi River, between New Orleans and Natchez. The boat was built in Kentucky and floated down to New Orleans. The engine was constructed in Philadelphia under the supervision of Mr. Evans and shipped by sea to New Orleans, but before it arrived the boat was destroyed by a hurricane. The engine was a high-pressure one, but its dimensions cannot be ascertained. It was set up on shore at New Orleans and used for sawing lumber, and its engineer reported that in the entire year after it went into operation it did not break down or get out of order enough to stop the mill for one hour.

Oliver Evans was an enthusiast on the subject of using steam for the propulsion of carriages on land. He predicted that carriages would one day be propelled on roads of wood or iron, and urged the construction of a railway between New York and Philadelphia, but could not find any one who would advance the necessary capital for the work. In 1787 he obtained from the State of Maryland



Evans' "Oruktor Amphibolis," 1804.

the exclusive right to use an improvement he had made in the steam-engine for propelling vehicles, but he found it more profitable to employ it for driving mills. Finding it entirely successful in this respect, he gave comparatively little attention to his earlier project.

In 1803–4 he built for the Board of Health of Philadelphia a dredging scow, which raised the mud from the river by means of a steam-engine.

To show that vessels could be moved on the water and carriages on land by steam, he fitted his scow with wheels at the place where it was built and propelled it by steam to the bank of the river, a distance of a mile and a half. There he launched her after removing the land wheels, and when she was in the water he attached a paddle-wheel to the stern. In an account he wrote of the performance, he says:

"I drove the scow down the Schuylkill with this paddle-wheel till I reached the Delaware, and then went up the Delaware to the city; leaving all the vessels going up behind me at least half way, the wind being ahead."

The movement of the scow from the place where it was built to the bank of the Schuylkill was the first instance of the propulsion of a land carriage by steam in America and the fourth in the world. His boat-carriage was called the "Oruktor Amphibolis."

Whether the engine which Evans built for the Mississippi would have been able to propel a boat against the current, is of course unknown, as the destruction of the boat by the hurricane and the employment of the engine in other work prevented the making of the experiment.

After demonstrating the feasibility of navigating the Hudson with steamboats, Fulton and Livingston turned their attention to the Mississippi.

There was some doubt about the possibility of stemming the powerful current of the great river, and before investing heavily in the enterprise those gentlemen determined to investigate the matter. For this purpose they engaged Nicholas J. Roosevelt, who has been mentioned elsewhere in connection with steamboat experiments, with the understanding that, if his report was favorable, the three men—Livingston, Fulton, and Roosevelt—would be jointly interested. In 1809 Roosevelt (who had been recently married) went to Pittsburgh, accompanied by his wife, where he built a flat-boat on which they descended the river. With the exception of about three weeks passed on shore at Louisville, and eight or ten days in a row-boat between Natchez and New Orleans, Mr. and Mrs. Roosevelt lived for six months on this flat-boat. Of this voyage the lady wrote as follows:

"The journey in the flat-boat commenced at Pittsburgh, where Mr. Roosevelt had it built. There was a huge box containing a comfortable bedroom, dining-room, pantry, and a room in front for the crew, with a fire-place where the cooking was done. The top of the boat was flat, with seats and an awning. We had on board a pilot, three hands, and a man cook. We always stopped at night, lashing the boat to the shore. The row-boat was a large one, in which Mr. Roosevelt went out constantly with two or three of the men to ascertain the rapidity of the ripples or current. It was in this row-boat we went from Natchez to New Orleans with the same crew. * * * We reached New Orleans about the 1st of December, 1809, and took passage for New York in the first vessel we found ready to sail. We had a terrible voyage of a month, with a sick captain. The yellow fever was on board; a passenger, a nephew of General Wilkinson, died of it. Mr. Roosevelt and myself were taken off the ship by a pilot-boat and landed at Old Point Comfort. From thence we went to New York by stage, reaching there the middle of January, 1810, after an absence of nine months.

"Once while in the flat-boat on the Mississippi we were aroused in the night by seeing two Indians in our sleeping-room, calling for whiskey. Mr. Roosevelt had to get up and give it to them before he could induce them to leave the boat."

At Cincinnati, Louisville, and other cities Mr. Roosevelt delivered his letters of introduction and was everywhere received with characteristic Western hospitality. He was listened to with respect and his accounts of the success of steamboats on the Hudson were accepted as truthful, but he was unable to inspire the Western people with faith in his project. They pointed to the swift currents of the Ohio and the Mississippi and showed how different they were from the gentle flow of the Hudson, and from first to last he received scarcely a word of encouragement. He was regarded as a visionary enthusiast whose schemes could only bring financial loss to those who engaged in them.

The pilots and boatmen were as incredulous as the merchants of the cities and the residents along the river; they could not believe it possible for a steam-engine to move a boat against the current of the river, and some of them did not fail to hint that the explorer ought to be in a lunatic asylum. But he went patiently forward with his work of gauging and measuring the current of the river in many places, ascertaining the character and depth of the stream, the nature of the sand bars and their tendency to change their position with the annual floods, ascertaining the difference between high and low waters, and the alterations produced by the seasons. When he returned to New York he had a large amount of practical and statistical information which he laid before Livingston and Fulton, with a favorable report on the proposed enterprise.

They were so impressed with the report that they immediately arranged for him to return to Pittsburgh in the spring of 1810, to superintend the building of the pioneer steamboat of the West.

Mr. Roosevelt was again accompanied by his wife, who was thus the first woman to make the voyage in a steamboat on Western waters. She was a sister of J. H. B. Latrobe, of Baltimore, and the account which follows is condensed from a paper by that gentleman, which was read before the Maryland Historical Society, and published by that body in 1871.

In 1810 Pittsburgh was a city of small population, though of considerable importance geographically and commercially. The main part of the town was on the right bank of the Monongahela, and extended from the junction with the Allegheny for about three quarters of a mile up the former stream. There were few buildings on the Allegheny side, which was liable to overflow. Under a bluff called Boyd's Hill, and close to an iron foundry, the keel of Mr. Roosevelt's steamboat was laid. At the present time the depot of the Pittsburgh and Connellsville Railway covers the ground.

Fulton had made the plans for the steamboat before Roosevelt left New York. It was to be 116 feet long, with a beam of 20 feet. The engine was to have a cylinder of 34 inches, and the other parts of the machinery were in proportion to it. Owing to the stronger current of the Mississippi, the engines were made more powerful than for a boat of similar size intended for the Hudson.

There was no timber at Pittsburgh for building the boat, and men were sent into the forest to procure it. The necessary ribs, beams, and knees were obtained with much difficulty on the banks of the rivers that unite at Pittsburgh, and floated down to the temporary ship-yard. Much of the timber was unseasoned, as Mr. Roosevelt could not procure it in any proper condition, and was unwilling to wait for it to pass through the seasoning process. Whatever sawing was required on the spot was done in the old-fashioned saw-pits, which formed a feature of Pittsburgh in those days, but were long since abandoned.

The only workmen that could be found at Pittsburgh were those accustomed to building the barges at that time. Shipbuilders and all the machinists were brought from New York, and there was great difficulty in finding a shop where any part of the work on the engines could be performed. Certainly the builder of the first steamboat in the West conducted his work under many disadvantages.

Hardly was he fairly at work before a sudden rise in the river backed into his ship-yard and set afloat all his timber. This happened several times, and on one occasion, when the boat was nearly finished, the waters rose so high as to threaten to carry her from the stocks and set her adrift in the river before her time.

It was not until the month of September, 1811, that the boat was ready. She was successfully launched and received the name of New Orleans, in honor of the place of her destination, but many persons predicted she would never reach it.

As the time approached for her departure, and when it became known that Mrs. Roosevelt intended to accompany her husband, the many friends that she had made in Pittsburgh tried to dissuade her from the attempt. Some characterized her intention as folly and others as madness, and finding they could not shake her determination, they appealed to her husband. He was told he had no right to imperil his wife's life, however reckless he might be with his own, and at one time there were threats of taking her from him by force and locking her up out of his reach. But the woman had faith in her husband, and in spite of the showers of advice she did not waver in her determination.

In the latter part of September the boat made a short experimental trip on the Monongahela, and a day or two afterward started on her memorable journey. There were two cabins—a forward one, for gentlemen, and another aft, for ladies. The ladies' cabin was comfortably furnished and had four berths, and Mrs. Roosevelt was its sole occupant. Her husband was the only tenant of the gentlemen's cabin, as no one else had the temerity to apply for passage. The crew consisted of a captain, an engineer named Baker, a pilot named Andrew Jack, six deck hands, two female servants, one waiter, one cook, and a huge Newfoundland dog called Tiger. Fifteen human beings and a dog were the living occupants of the pioneer boat of the Mississippi valley on its pioneer voyage.

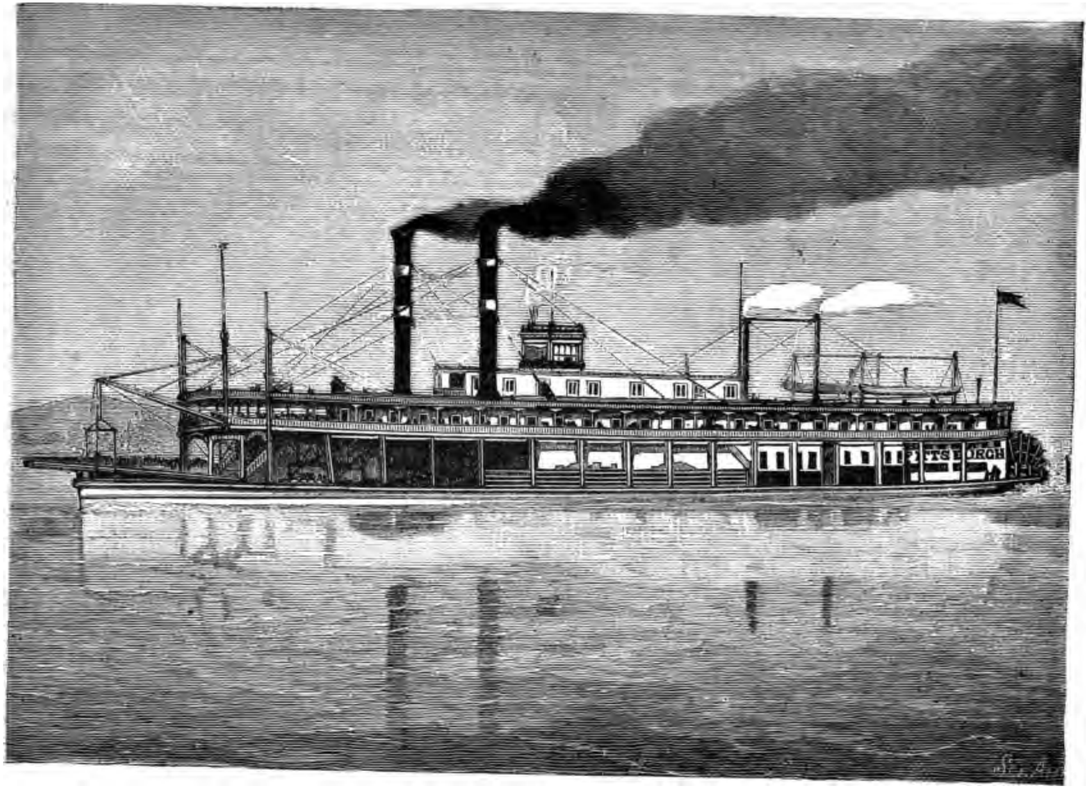
The entire population of Pittsburgh turned out to witness the departure of the New Orleans. Cheers echoed on cheers, flags were flown, handkerchiefs waved, and hats flung in the air in honor of the event. The boat steamed a short distance up the Monongahela, then swung around to her course, and disappeared behind the bends of the Ohio. Down she sped at the rate of eight or ten miles an hour, and in a little while all doubts concerning her ability to descend the river were set at rest. The problem of her successful ascent was yet to be solved.

Mr. Roosevelt was too much excited to sleep on the first night of the voyage, but paced the deck or stood or sat near the pilot from evening until morning. The engine worked smoothly in spite of its newness, and the engineer was happy. The pilot had had misgivings about being able to steer the craft, but found her easier to handle than any of the keel-boats or flats to which he was accustomed, and he too was filled with delight. Even the unpoetic deck-hands became excited at the novelty of the situation, and when in the morning all the crew were called to return the cheers of the inhabitants of a village that had turned out to greet the steamer as she sped on her course, there was never a happier set of men afloat on the Ohio.

On went the New Orleans without accident or hindrance, and on the second day after leaving Pittsburgh she reached Cincinnati and anchored in the river, as levees and wharf-boats were then unknown. Many of the acquaintances which Mr. and Mrs. Roosevelt had made on their first journey came off in small boats to visit them, and the whole population seemed to be assembled on the banks. "Well, you are as good as your word," said some of the visitors; "you have come in a steamboat, but we see you for the last time. Your boat may go down the river, but as to coming up it, the very idea is an absurdity!"

The keel-boatmen crowded around and cracked all sorts of jokes with the crew of the New Orleans, who had been selected from their own profession, but some of the flat-boatmen seemed to have a better opinion of the strange visitor. The steamer had passed several of these boats a short distance above Cincinnati, and, as they floated by with the current, some of them proposed a tow in case they were again overtaken. But all were agreed that the steamboat could never ascend the river, no matter how rapidly she could descend it.

The boat remained at Cincinnati only long enough to take in a supply of wood, and then proceeded to Louisville, which she reached at midnight on the first of October, 1811, on the fourth day from Pittsburgh. There was a brilliant moon-



The "Pittsburgh": Light-Draught Steamer of the Present Dav.

light, and as the New Orleans dropped anchor in the river opposite the town, the roar of the escaping steam brought all the inhabitants from their beds to ascertain the reason of the unusual noise. A letter of that time records the fact that some of the good citizens thought the comet of 1811 had fallen into the river and created the tumult!

The next morning Mr. Roosevelt's acquaintances and others of the citizens came on board and welcomed him heartily. They commended his energy, but repeated the same words of dismay that had been spoken at Cincinnati, as he could not possibly come back after once leaving them. It was the first and last time a steamboat would be seen above the falls of the Ohio, and this they said to their sincere regret. Still they were so impressed with his good faith that they gave a public dinner in his honor, at which a great many complimentary things were said and all sorts of good wishes expressed. To make a proper return for their hospitality, Mr. Roosevelt got up a dinner on board the boat, and invited as many as the forward cabin would contain.

While the feast was at its height there was a rumbling that brought everybody to his feet and caused a sudden rush to the deck. All the guests thought the steamer had escaped from her anchor and was drifting toward the falls of the Ohio, where everybody would be lost. Their dismay was changed to delight when they found she was steaming up the river, and, as she warmed to her work and increased her speed, they found themselves carried more rapidly than they had ever before travelled on the water. A good many of the incredulous were thus convinced of the success of the enterprise, and the faith in the steamboat was materially increased.

On his departure from Pittsburgh Mr. Roosevelt had intended to go as quickly as possible to New Orleans in order to place the boat on her projected route between that city and Natchez, but on reaching Louisville he found the elements against him. Just below Louisville are the celebrated falls of the Ohio, which can only be safely passed at a high stage of water, and at the time of his arrival the river was altogether too low for his purposes. It was necessary to wait for a rise which could only be brought about by a rain in the country above. To utilize the time as much as possible Mr. Roosevelt took the boat to Cincinnati, and thus convinced the doubting Thomases of that city of her ability to ascend the river as well as descend it. She was greeted with even more enthusiasm than on her first visit, as there could no longer be any question of her ability to stem the current. There was universal incredulity when she arrived there from Pittsburgh which was replaced by the most unbounded confidence when she arrived from Louisville.

It was near the end of November when the rise in the Ohio made its appearance and the water was deep enough to permit the passage of the falls. The depth in the shallowest part was only five inches more than the draft of the boat and the rise had ceased ; it was a very narrow margin, but Mr. Roosevelt determined to try it as it might be his only chance for months.

An extra pilot was engaged, all steam that the boilers would carry was put on, and away went the boat on her expedition. Mrs. Roosevelt refused to remain on shore but stood near the stern of the boat; the pilots were at the bow, and as the boat turned into the current the shouts of the crowd that had assembled to witness her departure grew fainter and fainter in the distance.

The safety of the boat depended on having her speed exceed that of the current, and as she dashed along with all the velocity her engines could give, added to that of the rush of the river, she seemed to be darting like an arrow. Rocks rose on each side of the channel, the water was dashed in spray on the deck of the boat, and sometimes the New Orleans seemed to pitch forward as though about to be swallowed up. Every one grasped some part of the boat for safety, and even the Newfoundland dog shook with terror as he crouched at Mrs. Roosevelt's feet. It was *une mauvaise quart d'heure*, as the French say, but it was quickly and safely over. The danger was passed and the New Orleans rounded to at the foot of the falls, where they discharged the pilot who had accompanied them through the dangerous channel.

From this point to the Gulf of Mexico there were no more falls or other obstructions to navigation, and the pioneers of steamboating on the Mississippi thought their voyage would not be marked with any further incident of importance. But Mrs. Roosevelt records that their passage of the falls of the Ohio was only the prelude to "days of horror."

While they were waiting at Louisville there were many days together when the sky had a dull leaden hue without a cloud. The sun was like a globe of red-hot iron at morning and evening; its color was brightened at noon, but through the whole day one could look steadily at it without blinking. The nights were starless and the moon even at the full was just barely visible. This atmospheric condition continued after the passage of the falls and was followed by the earthquake whose effects are still visible at New Madrid and other points.*

* Mr. C. J. Latrobe, in "The Rambler in North America," published a few years later, wrote as follows: "Many things conspired to make the year 1811, *the annus mirabilis* of the West. During the earlier months, the waters of many of the great rivers overflowed their banks to a vast extent, and the whole country was in many parts covered from bluff to bluff. Unprecedented sickness followed. A spirit of change and recklessness seemed to pervade the very inhabitants of the forest. A countless multitude of squirrels, obeying some great and universal impulse, which none can know

In his first visit in the flat-boat, Mr. Roosevelt found coal at several places along the banks of the Lower Ohio, and arranged for it to be mined and stored for the arrival of the steamboat whose keel had not then been laid. He found the coal ready, according to agreement, and took on as much as his boat could carry. When it was exhausted, he took in wood wherever he could find it. At least once in twenty-four hours the boat stopped for wood; there were no wood-yards then as in later days, and in nearly every instance the work of cutting and preparing the desired fuel was performed by the crew.

As the New Orleans neared the mouth of the Ohio, it was found that an unusual rise in the Mississippi had backed the latter into the former stream, and for a long distance all the low ground was flooded. Canoes of the Chickasaw Indians, who then inhabited that region, were paddled about among the trees; sometimes the Indians attempted to approach the steamer, and at others they fled when they saw it. At some of the places where

but the Spirit that gave them being, left their reckless and gambolling life, and their ancient places of retreat in the North, and were seen pressing forward by tens of thousands in a deep and solid phalanx to the South. No obstacles seemed to check their extraordinary and concerted movement. The word had been given them to go forth and they obeyed it, though multitudes perished in the broad Ohio which lay in their path. The splendid comet of that year long continued to shed its twilight over the forests, and as the autumn drew to a close, the whole valley of the Mississippi, from the Missouri to the Gulf, was shaken to its centre by continued earthquakes."

the boat stopped for wood, the Indians came out and talked, by signs and a few words of English, with the men.

They seemed to believe that the steamboat had some connection with the comet, as the sparks from the chimney bore a marked resemblance to the fiery tail of that erratic orb. They also attributed the smoky atmosphere to the steamer, and thought the earthquake was caused by the beating of its paddles. They looked on the first steamboat as an omen of evil, and for a long time afterwards all the Indians of the Mississippi Valley regarded the fiery craft with awe. As late as 1834, when the Chickasaws emigrated to the Indian Territory, hundreds of them refused to be carried on the steamboats, but made the long and weary journey on foot.

The first shock of the earthquake was felt while the steamer was anchored below the falls of the Ohio. The effect was much as though the steamer had suddenly run aground; the cable shook and trembled, and some of those on the boat felt the qualms of sea-sickness. Several shocks occurred during the night and for many succeeding nights. When the boat was in motion during the day, the tremblings of the earth were unnoticed, owing to the jar caused by the machinery and paddles. It is a curious circumstance that at such times the dog only was aware of the earthquakes; he would prowl, moaning and growling, about the boat, or come and place his head in Mrs. Roosevelt's lap.

At New Madrid they found a large part of the town had been swallowed up ; the inhabitants were in the greatest terror, and begged to be taken on board the steamer and carried to a place of safety. Transportation for so many or even a small number was impossible, as the accommodations of the steamer were very meagre, and the supply of food was only sufficient for the party, while purchase of other provisions on the way was extremely doubtful. The steamer continued on her voyage after a very brief halt, at this unhappy spot. At every point where she touched in the region covered by the earthquake they found the inhabitants in a similar state of alarm.

The earthquake lasted from November till the following March, and extended over an area of country stretching nearly three hundred miles southward from the mouth of the Ohio. The ground was shaken both vertically and horizontally, the horizontal movements being the most destructive. The ground rose and sank in great undulations ; fissures, sometimes more than half a mile long, were opened in the earth, and from these fissures mud and water were often thrown as high as the tops of the trees ; trees on the banks were toppled into the river, and the adventurers on the steamboat had several narrow escapes while tied up to the banks. So many times were they near destruction from this cause that they abandoned the practice of tying up to the bank at night, but preferred to make fast to the lower end of an island where there were no trees to endanger them.

One night while they were thus tied up, the boat was repeatedly shaken by logs running against it, but they supposed it was nothing but drift-wood, and felt no alarm. In the morning they found the island had disappeared during the night, and the tree to which their cable was fastened had sunk below the surface of the water, and was held by its roots. They were obliged to cut the cable in order to get free.

The pilot was bewildered, as the flood and earthquake had made so many changes, that the ordinary landmarks were not to be found, or, when found, were of no use. Tall trees that had been his guides were gone; islands had changed their shape or disappeared altogether. He found shallows where he had expected deep water, and deep water where there was formerly dry land; and where the river had previously flowed around bends, there were cut-offs, through which more than half of the great stream was pouring.

Long before reaching Natchez the steamer passed out of the region of the earthquake, and the only inconvenience was from snags and sawyers. They had a few races with the Indians, and on one occasion a large canoe filled with the red men came out of the forest abreast of the boat and made for her with all possible speed. As they were much more numerous than the crew, it was not desirable to receive them on board, and accordingly all steam was crowded on the boat, and the Indians were soon left behind, making the air ring with their shouts.

One night there was a sudden trampling of feet on deck, and Mr. Roosevelt and his wife thought the Indians were upon them. They rushed from the cabin, to find that their visitor was not a party of Indians, but something quite as alarming—the boat was on fire!

A servant had placed some green wood close to the stove, in order to render it fit for burning. The stove became overheated, and the wood took fire. The fire communicated to the joiner work near it, and the cabin would have been in flames very speedily if the servant, whose carelessness had caused the accident, had not awakened half-suffocated from the smoke. The fire was under good headway, but was extinguished, not, however, until it had destroyed or seriously defaced all the interior work of the cabin

Nobody slept for the rest of that night, and the incident did not tend to reassure the travellers or make them content with their floating home.

The Mississippi steamboat burns like tinder, and when once a fire is fairly started it is not often extinguished. Many lives have been lost by conflagrations on the great river of the West, and the most horrifying annals of the Mississippi and its tributaries are those which chronicle the burning of steamboats. In one accident of this sort no less than sixteen hundred lives were lost.

At Natchez the romance of the voyage ended. The travellers were received with the same hospitality as at Louisville and Cincinnati, and later on similar courtesies were shown them at New Orleans. From Natchez to New Orleans the river is deeper and more moderate in its current than above the former city, and there was no incident worthy of record in the voyage to the steamer's destination.

The pioneer steamboat took her place on the line between Natchez and New Orleans; in due time she was followed by the Vesuvius and the Etna, and these in turn were followed by others. Steamboats multiplied rapidly on the great river of America. In less than twenty years from the adventurous voyage here recorded they were counted by dozens and almost by hundreds, and penetrated through all the tributaries of the Mississippi over navigable courses, with an aggregate of more than twenty thousand miles.

Mr. Latrobe adds to this narrative as follows:

"Although forming no part of the voyage proper, yet, as this has been called a romance, and as all romances end, or should end, in marriage, the incident was not wanting here. The captain of the boat, falling in love with Mrs. Roosevelt's maid, prosecuted his suit so successfully as to find himself an accepted lover when the steamer reached Natchez. A clergyman was sent for, and a wedding marked the arrival of the first steamboat at the chief city of the Mississippi."

CHAPTER XI.

Early navigation of the Mississippi—Keel-boats, flat-boats, and rafts—Their peculiarities—Reminiscences of the keel-boatmen—Mike Fink and his tragic death—The New Orleans and her successors—First steamboat from New Orleans to Pittsburgh—Racing on the Mississippi—The last great race—Snags, sawyers, and the Red River raft—First ascent of the Mississippi by steam—What the first steam-whistle did.

PREVIOUS to the introduction of steamboats on the Mississippi and its tributaries the navigation of those rivers was conducted with several kinds of craft. They were respectively called keel-boats, barges, flat-boats, and rafts. Flat-boats and rafts are not unknown at the present day, though their numbers are not as great as in past years; but the death-knell of the keel-boat and barge was sounded when steam navigation was successfully established. This important feature of a by-gone age merits a description, as it was a marked characteristic of our Western civilization.

The keel-boat was long and narrow, sharp at both ends, and of light draft. When it had a house in the centre, it was dignified into a "barge"; but if the house was not there, the original name was retained. In descending the river it floated with the current, and the work of the crew of fifteen or twenty men was not severe. Laden with the products of the upper part of the Mississippi valley, and perhaps with a few passengers, the keel-boats went down the river to New Orleans. Returning, they brought cargoes of goods destined for consumption in the upper country—sometimes on the account of the owners of the boats, but more frequently as freight, for which a fixed price per ton or hundred-weight was paid.

The ascent of the river was long and tedious, as it was necessary to stem the powerful current of the Mississippi for many hundreds of miles. This business developed a peculiar race or class of men that disappeared with the adoption of the steamboat, and is known at present only in tradition or in the memory of that oft-quoted authority, "the oldest inhabitant."

On each side of the keel-boat was a plank or board extending from bow to stern, and known as the "walking-board." The crew was equally divided on the two sides of the boat, and each man was provided with a long staff, known as a "setting-pole." The lower end of the pole was planted or "set" in the bottom of the river and the other pressed against the shoulder of the man who handled it. Having placed the pole properly, the man walked from the bow to the stern, and the united force of the crew thus propelled the boat up the stream. A steersman was at the stern to direct the course of the boat, which he did by means of a long oar that had a tremendous leverage against the water.

The life of the keel-boatman was a laborious one, but it developed a wonderful power of muscle that was often used for less honorable purposes than propelling a vessel along the great river. When the crews of two boats happened to meet at a landing-place, a fight was a very likely occurrence, especially if each crew possessed a man of more than common renown for his prowess. If a keel-boatman claimed never to have been whipped, he was obliged to try conclusions with every man who chose to assail him, and the number of such was not small. Sometimes when two or three crews were camped together at night the most perfect harmony would reign until some one would imitate the crowing of a cock. Then from another crew would come an answering crow, and a combat for the local championship would follow immediately.

Certain codes of etiquette were binding on all keel-boatmen, though they were never formulated in writing or made the basis of a labor union. The men were a terror to all the towns and villages along the river, as the local police were utterly unable to control them, and they gave free rein to their fancies in the way of rough practical jokes on peaceable inhabitants or on each other. They were unerring shots with the rifle, which was always within reach, while they were working at oars or poles in their voyages on the river. If a deer or a bear made his appearance within range on the banks he was a mark for the rifle of the man who first saw him, and a shot was rarely thrown away. They did fine service at the battle of New Orleans (January 8, 1815). "The hunters of Kentucky," whose exploits on that memorable day have passed into song and history, were mainly keel-boatmen from the upper waters of the Mississippi and Ohio.

With the rifle-ball and at long distances they would cut the hat-band of a fellow-boatman or upset a coffee cup that might be resting on his knee. To cut off the head of a turkey at a hundred yards, while the bird was in motion, was a frequent feat, and at night they would snuff a candle at fifty paces, and leave it burning or extinguished as they chose. In the battle of New Orleans many of them suggested the place where they intended to hit an enemy, and after the battle was over their predictions were found to have been verified.

One of their favorite amusements was to "drive the nail";—a nail would be driven half its length into a tree, and then sent home to its place by the rifle at forty paces. When two of them quarrelled and afterwards made friends, their test of amity was to shoot a small object from each other's heads. One of the most renowned keel-boatmen was Mike

Fink, and his reputation as a marksman was of the best; he lost his life in one of these peculiar tests of reconciliation.

Mike had quarrelled with a fellow-boatman, and after they made up their differences, the usual ceremony was ordered. The man put an apple on his head, and the regulation distance was paced off; Mike fired, and the man fell to the ground as if dead. His brother, who was standing near, immediately turned and shot Mike through the heart; a few moments later the man rose to his feet stunned, but not hurt beyond a crease in the scalp. Mike had shot between the apple and the skull, as he would have "barked" a squirrel from a tree. Whether he did it by design or accident was of course never known, but it is supposed to have been done from mere wantonness.

In spite of their lawlessness and their frequent depredations upon the store-houses of farms or the products of field or orchard, these men had a keen sense of honor, which was very rarely transgressed. They could be implicitly trusted with goods or money for transportation, and if any thing in their charge was lost or damaged, they paid its full value without hesitation. When they interfered in the quarrels of others, they always took the side of the weaker; if two rival crews were about to fight, an equal number of men was told off from each, and the contest was not interfered with by the rest.

When a crew was paid off at the end of a voyage, there was a season of wild debauchery until the money was gone and the men had found work again. A keel-boatman who consented to work on shore immediately lost caste among his fellows, and could not associate with them till he took to the river again.

The ascent of the river from New Orleans to Louisville, with the keel-boat, occupied from one hundred to one hundred and twenty days, and the downward journey was rarely less than forty. The flat boats and rafts did not return at all, but were broken up at New Orleans and sold for their timber, while their crews came home on foot or shipped as hands on the keel-boats. The flat-boat was more familiarly known as the "broad-horn"; it was a hundred feet long by thirty broad, square at the ends, and not infrequently it reached a length of one hundred and fifty feet, with proportionate breadth.

The broad-horns were built on the upper rivers, and laden with corn, wheat, and other produce of the country, and their great length and width enabled them to carry enormous cargoes. With the rise of the river in autumn the boats started for their destinations; they floated with the current, where they were kept by the enormous oars in the hands of the steersman and one or two men on each side. Keel-boats, and afterwards steamboats, were required by the law of the river, and also by a regard for their own safety, to give a free road to the broad-horn; the greatest delight of the flat-boatman of modern days is to compel a first-class steamboat to change its course in order to avoid contact with his unwieldy craft.

Rafts are often of a size that makes the broad-horns appear diminutive, and sometimes they carry quite an extensive population. A raft is managed by men at bow and stern, and the steamboats always seek to maintain a respectable distance between themselves and these great masses of floating timber. The ire of a raftsman can be easily roused, and his combative qualities developed, by remarks relative to the speed of his vessel, its liability to leak, and a query as to how often he finds it necessary to pump the raft dry.

But to return to the steamboat. The New Orleans was sunk by a snag near Baton Rouge, a few years after the voyage narrated in the last chapter, but not until she had returned to her owners much more than the thirty-eight thousand dollars expended in her construction. About 1850 her timbers were found in a very good state of preservation; they were discovered during an unusually low stage of the river, where they had lain for more than a quarter of a century.

The Enterprise, one of the immediate successors of the New Orleans, was the first steamboat to make the trip from New Orleans to Pittsburgh. She left the former city early in 1815 with a cargo of ordnance stores, and reached Louisville in twenty-five days; the time consumed on the rest of her trip to Pittsburgh is not given. The river was high at the time, and the boat saved a considerable distance by "chutes" and passages that could not be used in the middle or lower stages. She was commanded by Captain H. M. Shreve, the inventor of the first snag-boat and the founder of Shreveport, Louisiana. On her arrival at Louisville there was great excitement; triumphal arches were erected, cannon were fired, and a public dinner was given to the captain for his successful ascent of the great river.

While responding to the toast in his honor Captain Shreve taxed the credulity of his listeners by saying that under more favorable circumstances he could make the journey in twenty days. In 1823 there were similar rejoicings at Louisville when a steamer arrived at New Orleans in fifteen days and six hours. At the banquet in his honor the captain said the upward passage might possibly be made in fifteen days, or in six hours less time than he had taken. Some of his listeners agreed with him, but many shook their heads. Little more than a decade later the time of the trip was reduced to less than eight days; in 1840 it was inside of six days; in 1850, inside of five days; and in 1853 the voyage from New Orleans to Louisville was reduced to four days and nine hours.

The distance is fourteen hundred and eighty miles and the average speed for the trip in the instance last mentioned was fourteen miles an hour. It was in a race between the steamers Eclipse and A. L. Shotwell, which was won by the former by only fifty minutes; seventy thousand dollars were wagered between the owners of the boats and there were private bets to a much greater amount.

Steamboat racing was for many years one of the pastimes of the Mississippi, and many interesting stories are told concerning these trials of speed. When two crack boats happened to be going the same way a race was almost among the certainties, and if it was announced beforehand both boats were pretty sure to be crowded in order to enjoy the dangerous sport.

Dangerous it was, as the contestants would carry all the steam to which they were entitled by law, and frequently a great deal more. Pine knots and sides of bacon were used as fuel; tar was often poured over the wood to make it burn more fiercely; and coal was drenched with turpentine, whiskey, or other spirits. A negro was sent to sit on the safety valve, or if he could not be spared from his work weights were placed upon it to hold it down. There is an anecdote of an old lady who took passage on a steamboat at Cincinnati, but before doing so she exacted a solemn promise from the captain that there should be no racing. "I'm afraid of my life," said she, "and I don't want to be on any boat that races. Besides," she added, "I 've a hundred barrels of bacon on board as freight, that I'm taking to market, and I don't want any thing to happen to *that.*"

During the downward trip they overhauled a rival boat and tried to pass it. The old lady became excited over the contest, forgot all about her scruples on the subject of racing, and urged the captain not to be left behind. "I can't beat that boat," was the captain's reply, "with the sort of stuff we 're burning. If I only had some bacon I could do it."

"Well, captain," said the old girl, "I 've got a hundred barrels of bacon down there, and you can jest use it up if you 'll only get ahead."

The captain took her at her word, and also took the bacon. The other boat was distanced, and, as no accident happened, everybody on the winning craft was happy.

In the race between the Eclipse and Shotwell it was stipulated that both boats should make certain landings for passengers, but they were not required to carry freight. The landings were made by means of the local ferry-boats, which came out in the river to meet them, fastened alongside, and exchanged passengers without the necessity of the rival racers slackening speed. Wood was taken at the wood-yards in the same way. Flat-boats laden with wood dropped into the river as they saw the steamers coming, and were made fast against the rapidly moving boats. The wood was hastily thrown on the deck, and then the flat was cast off and drifted back to its yard, and this process was repeated at all the wood-yards where either boat was supplied.

The engines hardly ceased their pulsations from the beginning to the end of the voyage, and on the part of the river between Natchez and New Orleans, where the current is sluggish, the boats made eighteen miles an hour. No accidents happened to either of the boats, but this is by no means the uniform history of races on Western rivers. Over-pressure of steam has caused explosions in which many lives have been lost, and boats have taken fire from the carelessness and excitement consequent upon a race. Of late years this form of sport is rarely heard of, and it is possible for two steamboats to travel along the same course without endeavoring to outstrip each other.

The following table shows the progressive improvement made in the speed of the boats from New Orleans to Louisville from 1815 to 1853, the year when the highest speed was reached;

DATE.	NAME OF STEAMER.	DAYS.	HOURS.	MINUTES.
May, 1815	Enterprise.	25	2	40
April, 1817	Washington.	25	00	00
Sept., 1817	Shelby.	20	4	20
May, 1819	Paragon.	18	10	00
Nov., 1828	Tecumseh.	8	4	00
April, 1534	Tuscarora.	7	16	00
Nov., 1837	General Brown.	6	22	00
Nov., 1837	Randolph.	6	22	00
Nov., 1837	Empress.	6	17	00
Dec., 1837	Sultana.	6	15	00
April, 1840	Edward Shippen.	5	14	00
April, 1842	Belle of the West.	5	14	00
April, 1842	Duke of Orleans.	5	23	00
April, 1844	Sultana.	5	12	00
May, 1849	Bostona.	5	8	00
June, 1851	Belle Key.	4	23	00
May, 1852	Reindeer.	4	20	45
May, 1852	Eclipse.	4	18	00
May, 1853	A. L. Shotwell.	4	10	20
May, 1853	Eclipse.	4	9	30

The race between the Eclipse and Shotwell was the last great one in the history of steamboating on Western waters, and the time made by the Eclipse has never been beaten.

The Robert E. Lee, in June, 1870, made a run from New Orleans to St. Louis in 3 days 18 hours and 14 minutes. The Natchez left New Orleans at the same time and ran to St. Louis in 4 days and 47 minutes. The distance is 1,170 miles, or 310 miles less than from New Orleans to Louisville.

Steamboating on the Mississippi and its great tributaries was at its height between 1850 and 1860.

In 1858 there were on the Mississippi and its tributaries eight hundred and sixteen steamboats, with an aggregate capacity of 326,443 tons. The Enterprise and her sisters had a capacity of from seventy-five to one hundred tons; the boats of 1850–60 often exceeded two thousand tons in measurement, and could carry cargoes of more than three thousand tons each, in addition to several hundred passengers. Since that time steamers of even greater capacity have been built, chiefly for the conveyance of freight. The steamboat passenger business has declined owing to the extension of railways in every direction, and their reduction of the time required for a long journey. Ordinarily the best of the steamboats require five or six days for the trip from New Orleans to St. Louis or Louisville, which the railway can easily make in three. The American is generally in a hurry, and consequently the steamboat cannot compete favorably with the railway for through passenger travel.

The Mississippi steamboat is so unlike that of any other river system of the world that it merits a special description. Her bottom is flat, as she must draw the least possible amount of water; —some of the enormous craft capable of carrying three thousand tons of freight can pass a shallow of five or six feet with ease and safety, while the smaller boats—with wheels at the stern—for the navigation of the tributaries of the upper Mississippi and Missouri require only fifteen or eighteen inches.

Some of the captains of the stern-wheelers boast that they can run where there is a heavy dew, and others profess an ability to navigate the moisture on the outside of an ice-pitcher in a muggy day. Stories have been told of sending a deck hand out with a sprinkling-pot in order to dampen the bed of the river enough to allow a boat to proceed, but they cannot be received as entirely truthful.

A first-class boat on the Mississippi will measure about three hundred feet in length by sixty in width. From her keel to the roof of the upper cabin is about forty feet, and above this cabin is the "Texas," which contains the quarters of the officers and servants, and is somewhat shorter and narrower than the cabin. Above the "Texas" is the pilot-house, a room from ten to twenty feet square, and sixty feet above the keel. It contains an enormous wheel, and is equipped with speaking tubes and bell ropes for communication with the engineer, and it has glass windows all around so that the pilot can see in every direction.

The main deck is only two or three feet above the water, and below it is the hold where a large amount of freight can be stored. The boilers and engines are on this main deck; freight is also piled upon it, and the steerage passengers have their quarters there. The main cabin is above all the machinery, and is a broad saloon with a row of roomy cabins on either side ; the cabins have doors opening into the saloon and other doors opening upon the "guards," which form a pleasant lounging place where the scenery of the banks can be studied or the time whiled away in reading or other occupations.

The forward part of the saloon is called the "Social Hall," and it is there that the bar is located, cards are played—generally for money and often for high stakes,—and masculine passengers cultivate each other's acquaintance. The ladies' saloon is at the stern ; it is divided from the Social Hall by a curtain which is drawn at night and sometimes in the day, but on many of the smaller boats the division between the two is by an imaginary rather than by a real line.

At the hours of meals the whole saloon or such part as may be needed is utilized as a dining hall, and in the evening it may form a temporary dancing hall, the music for which can be readily supplied by the colored servants of the boat. The price of passage is inclusive of meals and lodgings ; on the best of the boats the table is not inferior to that of first-class hotels on shore and many travellers have pronounced it superior.

There are two engines on all the side-wheel boats, and the wheels are independent of each other. A few boats have low-pressure engines, but the great majority are high pressure, and discharge the steam directly into the air, sometimes through steam-pipes, and sometimes through the enormous chimneys that rise through the double line of cabins, so that their presence is not noted by the sojourners in the saloon. The boilers are usually tested for 150 or 200 pounds pressure to the square inch, and the engines are worked with from 90 to 120 pounds. When racing, a boat carries all the steam that the inspectors permit, and sometimes a good deal more. Hence the fearful explosions, generally with heavy loss of life, that are recorded in the annals of Western navigation.

But explosions and conflagrations are not the greatest of the dangers of Western steamboating. Snags and sawyers have brought many boats to grief, especially on the Missouri, where they are more numerous than elsewhere. A snag is the trunk of a tree whose roots have become firmly imbedded in the bottom of the river, while the top is at or near the surface, either above or just below it, the greatest danger being in the latter case. A sawyer is similar to a snag, but the roots of the tree, instead of being firmly, are loosely fixed, so that the top has a sawing motion. The current carries it below the surface, until the tension of the roots causes it to rise, when it slowly appears above the water, and as slowly disappears again.

Snags and sawyers are the great dread of steamboatmen, and in fact of all classes of navigators of the Western rivers. When a boat runs fairly on either of them her destruction is almost a certainty. In one instance on the Missouri River a boat was impaled on a snag like a fly on a pin. It entered her hull just forward of the engines, rose through all her decks, and killed her pilot as he stood at the wheel. The snag may point either up or down the stream, but the direction of the sawyer is always with the current.

A great deal of money has been spent—partly by the General Government, and partly by the State authorities, and the cities and counties interested in river navigation, in the removal of snags and other obstructions. Snag-boats, built especially for this work, are employed. They are provided with suitable machinery and tackle for lifting a snag from its bed or cutting it off far below the surface of the water. The greatest work of this kind has been in the "Red River raft," a tangle of trees and smaller driftwood that formerly filled the Red River for a distance of nearly forty miles. It was a formidable barrier to navigation. The United States Government began work upon it more than fifty years ago, and large sums of money have been spent upon it from time to time.

Captain Shreve opened a channel through the

Red River raft in 1835–1839, but it steadily extended at its head from the annual accumulation of drifting timber. A channel was opened in the newly formed raft between 1840 and 1850, but in 1871 the foot of the raft was at a point above that where the head had been when Captain Shreve began his work. It has since been opened through its whole length, but must be watched and worked upon every year to keep it from closing again.

The oldest existing steamboat company in the West, and probably in the world, is the United States Mail Line between Cincinnati and Louisville. It was organized in 1818, seven years after the people of those cities predicted that neither Roosevelt's boat nor any other could ever ascend the Ohio, and has owned a great many boats. It built the first steamboat, the General Pike, designed for passengers exclusively. This boat made the trip from Louisville to Cincinnati in thirty-one hours, a journey which was reduced to nine hours before the middle of the century. Owing to the competition of the railways, the business of the steamboats on this and most other river lines is less profitable than it was thirty years ago.

The Missouri was first ascended by steamboats in 1819, when three small boats chartered by Government were sent there with an exploring party.

The members of the party travelled along the shore, while the boats carried their baggage and supplies. Sometimes the explorers were separated from their boats for days, and on one occasion they were robbed by the Pawnee Indians and left hungry and half-naked, until relieved by the friendly Kaws and conducted to the boats. One of the steamers had the figure-head of a serpent at the prow, which was utilized as an escape pipe. When the Indians saw this hideous object breathing steam, they fled in terror, as they imagined that the evil spirit had come and was ready to swallow them.

Progress with these boats was very slow, as their engines were weak, and they frequently ran on sandbars. On their return journey they dropped down the stream stern foremost, as they could thus be more easily managed than if coming head on. At that time the use of the stilts, by which steamers are lifted off from sandbars, was unknown, and when boats ran aground, especially in descending, it was a very serious matter.

Steam whistles were introduced on the Missouri River in 1844, and on the Mississippi two or three years earlier. The first steam whistle on a steamboat was on the "King Philip," running on Narragansett Bay, in 1837. Stephen D. Collins, engineer of the King Philip, had seen a whistle on a locomotive, and ordered one for his boat. At first the innovation was unpopular, on account of its noise, but its usefulness for signalling purposes led to its rapid adoption as soon as it became known.

In the autumn of 1844, the new steamboat Lexington started from St. Louis for the Missouri River. She had a steam whistle, the first on the Missouri, and the fact was known only to Theodore Warner, one of the passengers. While the passengers were playing cards in the evening, after leaving St. Louis, Warner turned the conversation to steamboat explosives, and remarked that he felt perfectly safe on the Lexington.

"Why so?" inquired Mr. Yocum, a planter from Platte County.

"Because," was the reply, "she's got a new patent safety-valve that tells the passengers when she's going to blow up. It makes a most unearthly noise, and when you hear it, it's time to get aft or jump overboard."

He said this with a most solemn countenance while studying his cards, but in spite of his seriousness some of the passengers were skeptical, though Yocum was not. While the passengers were at breakfast next morning, the steamboat was approaching Washington, Missouri, and the whistle was blown for the first time. Horror was depicted on some of the faces, and the words of Warner were remembered. Yocum sprang from his seat, his face blanched and his hair in bristles, and shouted:

"Run for your lives; the darned thing 's going to bust!"

Everybody ran for the stern of the boat, and it required considerable exertion on the part of the knowing and cooler ones to keep Yocum and a few others of the excited passengers from jumping overboard.

The New Orleans and others of the earlier boats on the Western rivers had their boilers in the hold, and were propelled by single upright engines, patterned after those of the Clermont and other Hudson River boats. In 1816, Captain Shreve built the Washington, at Wheeling, Virginia, and introduced several novelties. He placed the boilers on the main deck, built a hurricane deck over them, used two horizontal direct-acting engines, driven by high-pressure steam without condensation, and attached them, one on each side of the boat, to cranks placed at right angles. He also adopted a cam cut-off for expanding the steam, and introduced the flue-boiler of Oliver Evans. The arrangement of boilers and decks became popular at once, and thus the Mississippi steamboat received the shape it has at the present day.

During the Civil War there was a considerable fleet of light-draft gunboats on the Mississippi, some specially built for the purpose, and others altered from existing craft. Several were of the "Monitor" pattern, with revolving turrets, and so constructed that they could be easily handled in the tortuous river.

"The Ozark," Light-Draft Gunboat.

Our illustration shows the Ozark, which was built at Mound City in 1863.

CHAPTER XII.

Introduction of steamboats on the great lakes—The "Walk-in-the-Water"—Growth of the northern lake fleet—First steamers on the Pacific—Early steamers to and in California—The Senator and the Golden Age—Steam lines across the Pacific—Chinese steamer at San Francisco—First steamships around the world.

WE will now leave the Mississippi, and turn to other inland waters beyond the valley of the Hudson.

The advantages of steamboats on the great lakes of the United States were not likely to escape attention, but nothing was undertaken in that direction until several years after the successful navigation of the Mississippi by Roosevelt and his successors.

In 1816, the steamer Ontario was built at Sackett's Harbor for the navigation of the lake whose name it bore.

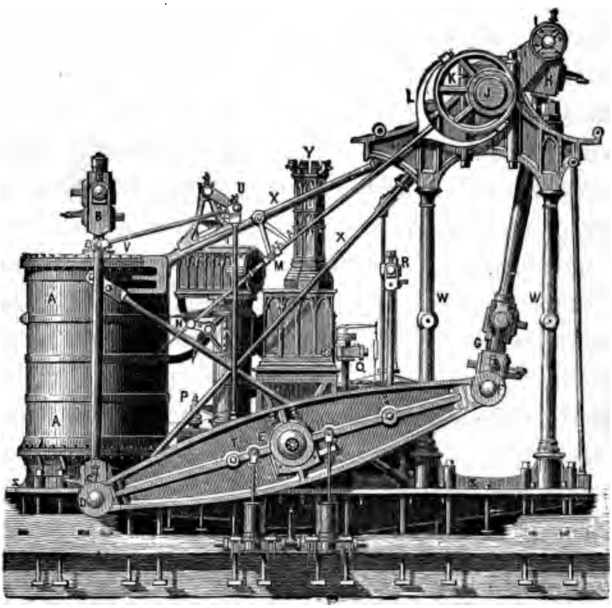
The pioneer steamboat of the great lakes above Niagara Falls was the "Walk-in-the-Water" (three hundred and sixty tons), which was launched at Black Rock, below Buffalo, on the 28th of May, 1818. Her hull was built by Noah Brown, of New York; her engine and boilers were made in New

York, and hauled overland by teams from Albany to Black Rock. There was only a small population on the shores of the lakes at that time, and the cargoes of the new boat were chiefly supplied by the American Fur Company.

There is a tradition that she was named after a Wyandotte chief, "Walk-in-the-Water," and another that her appellation came from a remark by an Indian as he saw the boat in motion on the day she was launched. For two or three years she was considered sufficient for transacting the commercial business of the lakes; in 1818 she did not go beyond Lake Erie, but in 1819 she was sent to Mackinaw with a cargo of goods for the American Fur Company.

Navigation was confined to Lakes Erie and Huron until 1827, when the waters of Lake Michigan were first plowed by steam. The first steamboat to visit Chicago was in 1832 (some say it was in 1831), with a detachment of government troops sent to garrison the fort and afford protection to the few inhabitants against the Indians. In 1831, there were eleven steamboats navigating the lakes, with an aggregate capacity of 2,260 tons, so that the average size was not large. In 1836 there were forty-five steamboats of 9,119 tons, and in 1847 the steam fleet of the lakes comprised sixty-seven side-wheel boats and twenty-six screw steamers. In 1840 the trip between Buffalo and Chicago, including stoppages at Detroit and other intermediate ports, occupied fifteen days, and there were forty-eight steamboats engaged in the trade.

In 1884 the steam fleet of the northern lakes comprised 1,296 vessels of all classes, with an aggre-



The Side-Lever Engine.

gate measurement of 257,083 tons. What an enormous growth since the launch of the Walk-in-the-Water in 1818; 5,410 licensed officers, including masters, mates, engineers, and pilots, were required for the management of this fleet. It must be borne in mind that these figures do not include the steamers belonging to ports in the British dominions which lie along one side of all the great lakes, with the single exception of Lake Michigan, the only one of the chain which is wholly within the United States.

As on the ocean the screw has largely supplanted the paddle-wheel for the propulsion of the steamer on the lakes. The paddle is still in use on many of the smaller coasting boats, but the steamers making long courses and carrying heavy cargoes are nearly all propellers. As early as 1854, side-screw propellers were advocated as a substitute for the paddle-wheel; in that year the steamer Baltic was thus altered at Buffalo. Her paddle-wheel engines were removed and replaced with side-propeller machinery; the old engines were high-pressure, while the new ones were low-pressure. When altered she was run at her old speed with half as much fuel as formerly, and was able to carry much more cargo. She was the first steamboat on the lakes to which this principle was applied, but her success was not sufficiently marked as to lead to its general adoption. Some of the boats on the lakes at present have double screws, but the great majority are equipped with the single screw at the stern, as in the ordinary model of the ocean steamer.

The side propeller seems to have been tried for the first time in 1845, on the steamer Iron Witch, built by Ericsson, for R. B. Forbes, for the navigation of the Hudson. She was about three hundred feet long, and the first *iron* passenger steamer plying between Albany and New York. The Iron Witch, as originally equipped, proved a failure in speed; her machinery was removed to make place for paddle engines, with which she was a prosperous and profitable boat.

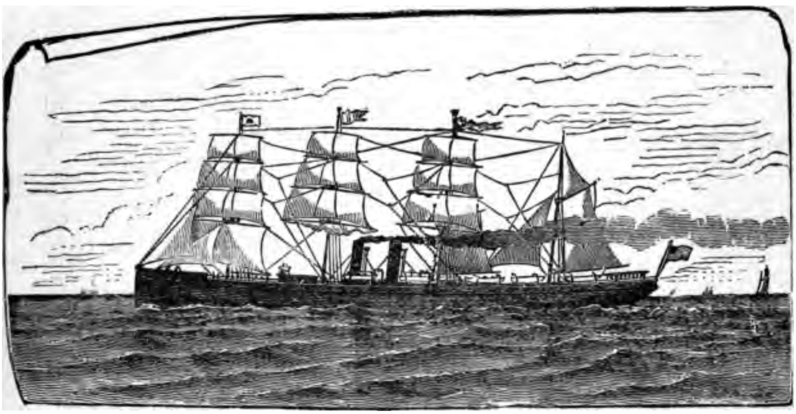
Previous to the discovery of gold in California in 1848 steam navigation was practically unknown on the Pacific coast of North America. In March, 1847, the Congress of the United States passed an act for the establishment of a mail service between New York and our Pacific coast, and a contract was made with A. G. Sloo, by which a steam line to cover the route in question should be put in operation. The line was established by Law, Roberts & Co., the principal parties in interest being George Law and Marshall O. Roberts. The Falcon, a chartered steamer, was the first to carry the American flag to Chagres and open the route.

The Ohio was the first steamer built under this contract, and immediately following her were the Georgia and the Illinois. The Ohio was 248 feet long, with 55 feet beam, and a measurement of 2,397 tons; the Georgia, for the same proportions, was 255 and 49 feet and 2,695 tons. The Illinois was 267 feet long on deck, 255 feet keel, 40 feet beam, and had 31 feet depth of hold. The engines of the Ohio and Georgia were side-lever, while those of the Illinois were oscillating; the average speed of the Ohio and Georgia was twelve knots, while the average of the Illinois was twelve and a half knots, with a maximum of thirteen and a half.

About the same time the Pacific Mail Steamship Company was organized, and for several years it ran in opposition to the line already mentioned. Steamers were built with great rapidity in 1848 and the few succeeding years, as the rush for gold developed an enormous business which was highly remunerative. The steamer California, 1,086 tons, built by W. H. Webb, left New York on the 6th of October, 1848, for the Pacific Ocean by way of the Straits of Magellan. She was the first American steamer on the Pacific, and her advent was the cause of much rejoicing among the dwellers on our Western shores.

She was followed by the Panama, 1,088 tons, and the Oregon, 1,699 tons, and not long after by the Tennessee, Golden Gate, 2,068 tons; Columbia, 778 tons; John L. Stephens, 2,189 tons; Sonora, 1,614 tons; Republic, 850 tons; Northerner, 1,010 tons; Fremont, 576 tons; Tobago, 189 tons; St. Louis, 1,621 tons; and Golden Age, 2,280 tons. A corresponding number of steamers, with about the same tonnage, was built for the Atlantic service. It will be observed that none of the ships on the Pacific side exceeded 2,300 tons, while most of them were below 2,000 tons; the measurements on the Atlantic side were somewhat larger on the average than for the Pacific service, but down to 1860 there were few, if any, steamers exceeding 3,000 tons.

The steamers that went to the Pacific in the



City of Peking.

early days found nothing ready for them, and the companies were obliged to establish their own repair shops at Panama, and also at the California terminus. The Pacific Mail Company built a dry dock at Benicia, California, a few miles from San Francisco, and also established there a foundry and machine shop, which is capable of constructing a marine engine of the first class, or performing any other work required on their largest steamers.

All the company's steamers are built on the Atlantic coast, and sent around by way of the Straits of Magellan ; the price of labor on the Pacific coast, and the high cost of materials for the machinery, render this plan more economical than it would be to build and equip the vessels at Benicia or San Francisco. In the early days, the cost of coal on the western side of the continent was very great ; at one time the Pacific Mail Company paid fifty dollars a ton for its coal at Panama and San Francisco, and for a considerable period the price averaged from twenty-five to thirty-five dollars. In the early days, coal was carried in sailing ships from the Atlantic coast ; afterwards it was brought from Australia, and still later coal mines were opened in California and along the coast of Oregon, Washington, and British Columbia. All the coal now needed there for steamship use is supplied from the mines of California and the northern coast, and the high prices of former days exist only in tradition.

All the early steamers of the Pacific Mail Line were built of wood, and propelled by side-wheel engines ; at present all its vessels are of iron, and propelled by screws, the old wooden steamers having been wrecked, burned, sold, or broken up. In 1867, the company established a line from San

Francisco to Japan and China, in accordance with a contract with the United States Government for the transportation of the mails ; four steamers, the Great Republic, China, Japan, and America were built for this service, all of them wooden vessels of about four thousand tons capacity, with walking beam engines and paddle-wheels.

In 1874 the company added the City of Peking and City of Tokio, two magnificent screw steamships of iron, and the largest ever built in America. They were each of 5,560 tons burthen, 423 feet long, 48 feet beam, and 38 feet depth of hold.

After the establishment of the line to Japan and China the Pacific Mail Company established lines to Australia and the Sandwich Islands, and also a service along the coast of Central America and Mexico. These lines are still maintained with varying fortunes consequent upon questions concerning compensation for the transportation of the mails.

The voyage of the Pacific Mail Steamship Company's steamer "City of New York" from New York to San Francisco in 1876 was remarkable. The total distance, 13,552 miles, was performed in 59 days, the actual steaming time being 54 days, 14 hours. The entire passage was made on the coal shipped at New York, none having been taken on board *en route*.

The figures were as follows:

New York to Cape Virgin, east entrance of the Straits of Magellan . . .	miles,	7,074
Through the Straits	"	340
Cape Pillar, west entrance of Straits of Magellan, to San Francisco . . .	"	6,138
The total distance, by observation, run was,	"	13,552
The total distance by screw . . .	"	14,235
The total revolutions of the engines during the voyage was		3,338,105
Total amount of coal consumed for steaming	tons,	1,440
Average consumption of coal per day .	"	26.4
" " " " mile .	pounds,	239
" revolutions per day, running time,		61,250
" per minute . .		42.53
" speed per day, running time . .	miles,	248⅓

The dimensions of the "City of New York" were: Length, 353 feet; beam, 40½ feet; tonnage, 3,019; engines, 1,000 horse-power.

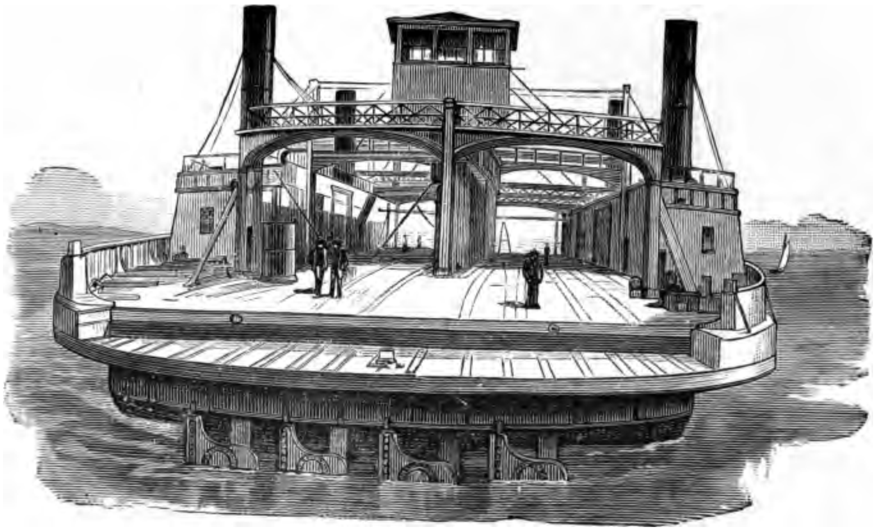
Steam navigation on the inland waters of California followed closely upon ocean navigation to the Pacific. As soon as it became certain that gold had been discovered in California and that there would be a rush of fortune-seekers to the Pacific coast, enterprising Americans determined to utilize the rivers flowing into San Francisco Bay. The steamer Senator, a boat of the North River pattern, was stripped of her upper decks and sent from New York to San Francisco by way of Cape Horn in 1848.

Early in the same year Capt. R. B. Forbes, of Boston, sent out the "Mint," an iron steamer seventy-five feet long and fifteen feet beam. She did not perform the voyage under steam, but was carried on the deck of the ship Samoset. She was stowed on the starboard side of the ship and the deck-house was removed to the port side, in order to balance the weight of the steamboat. Her engines were all ready for work, and she was launched soon after the Samoset's arrival in San Francisco.

The ship Edward Everett also took out a small steamer, which was named the Edward Everett, Junior. Steam was raised on her the day she was launched, but she proved deficient in speed, and was shortly afterwards sold to some circus men for $5,500. The honor of being the first steamer on the Sacramento River lies between the Mint and the Everett, Junior, and the friends of each can produce the most conclusive evidence in support of their claim. Neither boat had a long career, as both succumbed to the dangers of the river before reaching a green old age.

Rarely, if ever, has there been such a successful boat in a pecuniary sense as the Senator. During the early years of the California gold fever she had almost a monopoly of the steamboat business on the Sacramento, and it was for a long time a current saying in San Francisco that in 1849 and '50 the Senator earned her weight in gold. She made daily trips each way (120 miles), and the price of passage was $25, exclusive of meals. On single trips from San Francisco to Sacramento her receipts often exceeded twenty thousand dollars, and occasionally they reached the same figure on downward trips, just before the departure of a steamer for New York. An old Californian told the writer of this volume that drinks on board the Senator were one dollar each and the quality of the whiskey was very bad. "Coin was scarce," said he, "and when a miner called for a drink, he opened his bag of gold-dust, out of which the bartender took a pinch between the ends of thumb and forefinger. A pinch a drink was the regular tariff, and the owners of the boat sought for the men with the broadest thumbs and fingers to engage as bartenders. How much money the Senator made, I don't know exactly, and nobody does, as the owners kept their business to themselves, but it is safe to say she cleared a million and a half of dollars in five years."

The Senator was afterwards withdrawn from the Sacramento trade, strengthened in hull and upper works, and used as an outside steamer on the coast route between San Francisco and San Diego. Occasionally she was laid up when business was light, but she was kept in that service off and on until 1880 when she was dismantled. Her engines were removed and she was rigged as a barque and



The Solano, the Largest Ferry-Boat in the World.

sent on a voyage to Australia ; at last accounts she was still in use as a sailing ship.

The New World, a Hudson River boat, was sent to California a few years after the Senator, and continued in active service on the waters flowing into San Francisco Bay until she was broken up in 1883. Another New York boat which went to the Pacific coast was the Wilson G. Hunt ; she is now owned in Victoria, British Columbia, and is run as a regular steam-packet between Victoria and Nanaimo. The California, which was the pioneer steamship in the Pacific Ocean, is still in existence, but not as a steamer ;—her engines were removed several years ago and she is now a barque engaged in the lumber trade between Puget Sound and San Francisco.

Several fine steamboats have been built at San Francisco and neighboring places, and also on Puget Sound where lumber of the best quality is in great abundance. The fastest river boat in San Francisco waters is the San Rafael which was built in New York and then sent in pieces to San Francisco where she was put together again. The ferry-boats plying between San Francisco and Oakland, on the opposite shore of San Francisco Bay, are among the largest in the world ; one of them, the Solano, has a capacity, as reported by the Government inspector, of 3,549 tons !

In 1884 there were upon the Pacific coast a total of 387 steamers of all classes with an aggregate measurement of 99,532 tons. The total of licensed officers for these steamers (masters, engineers, mates, and pilots) was 1,752.

The establishment of the Pacific Mail line between San Francisco and Japan and China was followed a few years later by that of a rival concern, the Occidental and Oriental Steamship Company, consisting of British steamers chartered for the purpose. After a period of opposition the two companies became friendly, and for a decade or more have been running in perfect harmony. They have consolidated their offices in Japanese and Chinese ports and make alternate departures from either end of the route, so that travellers can count upon a steamer across the Pacific every twelve or fifteen days.

Ordinarily the voyage between San Francisco and Yokohama occupies twenty days, but it has been made inside of fifteen days, which is very good progress for a distance of nearly five thousand miles. The quickest trips are the eastward ones when the steamers are laden with the new crop of tea, which it is desirable to deliver in port as soon as possible.

At such times the "tea-train" is made up by the Pacific Railway companies; the cars are loaded at the side of the steamer, and as soon as the train is ready it is dispatched, with the right of way over every thing except passenger trains. Cargoes of tea have been delivered in New York in twenty-nine days from Hong-Kong; this allows twenty days for the steamship voyage and nine for the overland transit, making no deduction for the time spent in transferring the cargo at San Francisco.

A trans-Pacific line from one of the ports of Puget Sound is in contemplation and also another from Victoria, the terminus of the Canadian Pacific Railway. The latter certainly and the other possibly will be under the English flag, though the parties interested in the Northern Pacific Railway declare their intention of sending out steamers flying the standard of the United States.

China has made a move in the direction of taking a hand in the navigation of the Pacific. On the 31st of August, 1880, the Chinese steamer Hochung entered the custom-house of San Francisco, paying the regular tonnage dues of thirty cents per ton, and one dollar per ton extra dues on alien ships, the latter under protest. Extra duties of ten per cent. on the cargo were also paid under protest, and the whole matter was referred to the decision of the Secretary of the Treasury. The Hochung was also the first Chinese steamer that ever visited the Hawaiian Islands, which was in November, 1879, when she carried to Honolulu 431 Chinese immigrants.

A San Francisco paper said of this arrival, under the heading "China's Debut upon the Sea":

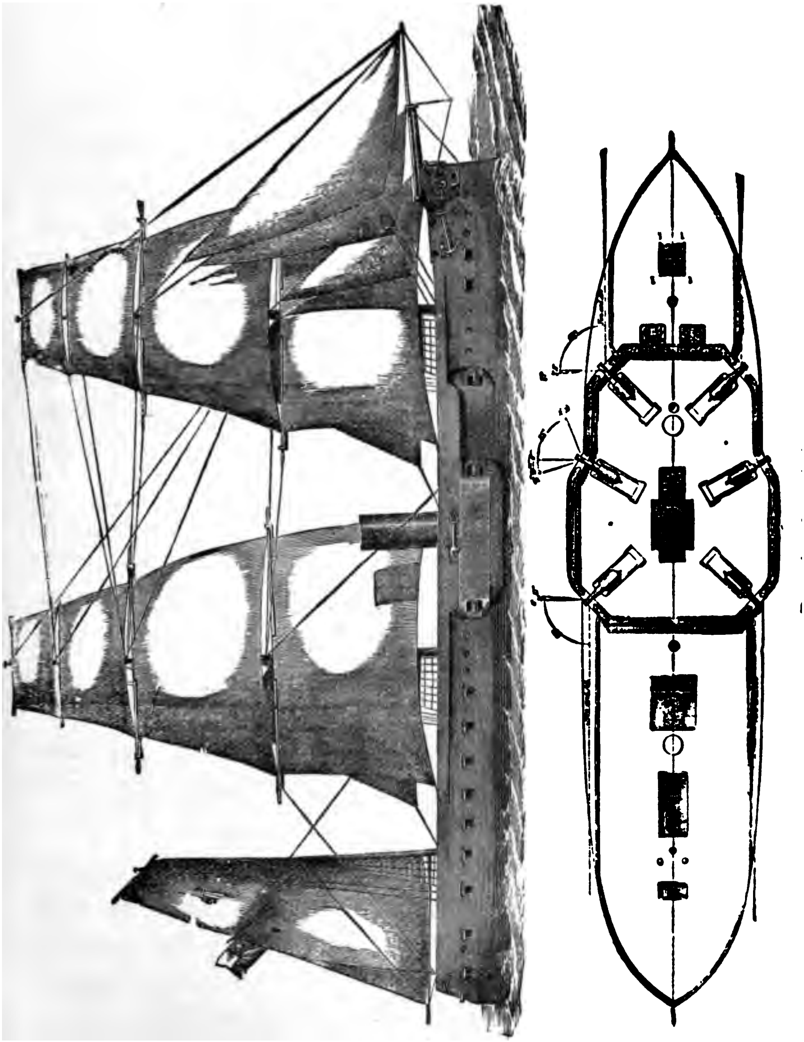
"The arrival at San Francisco on the 30th of August of the first Chinese steamer that had ever crossed the Pacific deserves commemoration. This steamer, the Hochung, appeared at the Golden Gate, seeking admision to a foreign port, nearly forty years after the isolation in which for ages China was encased was broken, and five of her ports were opened to the commerce of the civilized world. The treaty of 1842, by which this concession was secured to foreign trade, has borne fruit slowly; but the tardiness of the Chinese to undertake maritime enterprises is due not so much to their love of seclusion as to the difficulty of acquiring the art of navigation. This art is, and ever has been, one of the later acquisitions of nations. . . . It is no wonder, therefore, that the Chinese have taken forty years to master the nautical skill requisite for the accomplishment of this feat. But the beginning of ocean traffic is now made, and this field of commercial competition once fairly broken, there is reason to hope the Orientals will find it profitable. . . . In this maritime enterprise they are favored by the immense coal supply of the Middle Kingdom. Baron Richthofen, who carefully examined the coal-fields of China, says it is 'among the most favored countries of the world as regards the distribution of mineral fuel.' This able geographer computes from his own inspection that the 'quantity of very superior coal available for cheap extraction is so large that, at the present rate of consumption, the world could be supplied from Shansi alone for several thousand years.' This vast coal-bed is reached by the Yang-tse-Kiang (river), China's great commercial highway, navigable for large vessels twelve hundred miles from its mouth, and easily ascended by ocean steamers as far as Hankow, seven hundred miles from the sea. With such a magnificent deposit of mineral fuel suited for use on steam-vessels, the day is not distant when the Chinese, renowned for ages as dextrous mechanics, will be able, with a little nautical training, to carve out a bright future for their nation."

A telegraphic dispatch, dated London, December 7, 1881, announced that "the Meefoo, the first of a regular line of steamers under the Chinese flag, arrived in the Thames with three thousand tons of tea."

War steamers have followed commercial ones into the Pacific. The naval flags of all the great nations of the world are now a frequent sight on the great ocean; Chili and Peru have their fleets of ironclads, and some of their ships are worthy of most respectful consideration.

We will close this chapter on the history of steam navigation on the Pacific coast by mentioning an exploit of one of the vessels that afterwards became famous on the line between New York and San Francisco.

The steamer Golden Age was sent from New York to Liverpool in 1853; she was a paddle-steamer of great size and power, and had all the latest improvements in the science of steamship building. Among other innovations she had no bowsprit, which was then thought indispensable to the successful performances of an ocean steamer. Her owner decided to send her to Australia, and she had no difficulty in securing freight and passengers. She made the quickest passage on record



up to that time, and soon after her arrival at Sydney it was determined to load her for Panama.

She sailed from Sydney May 11, 1854, and in thirteen days reached Tahiti, where she coaled. The work took six days, and required twelve hundred tons of coal, at forty dollars a ton. On the 31st of May she sailed from Tahiti, and on the 19th of June reached Panama, just in time to transfer two hundred passengers, five million dollars in gold, and her Majesty's mails to the steamer Magdalena, which was ready to sail from Chagres for England. Letters by this trip reached London in only sixty-seven days from Sydney, which was by far the quickest passage then known.

The performance of the Golden Age was more satisfactory as a thing to boast of than from a pecuniary point of view, as the high cost of coal consumed on the voyage entailed a heavy loss on the owners. Had the Golden Age continued down the Pacific coast and around through the Atlantic to New York, she would have been the second commercial steamship to circumnavigate the globe, and possibly the first.

The first trip around the world by a merchant steamer was made in the same year—1854—by the English screw steamship Argo, of 1,850 tons measurement. She made the passage out to Australia via the Cape of Good Hope in sixty-four days, and returned via Cape Horn in the same time.

An English paper, commenting on this voyage, said: "Since the ancient days of Jason and the Golden Fleece several celebrated ships have borne the renowned name of Argo, and certainly we consider the present steamer not the least worthy of the number to be chronicled in history. She has proved herself one of the most notable pioneer ships of the nineteenth century."

It is said that the steamer Driver of her Britannic Majesty's navy, circumnavigated the globe in 1842–43. No details of her voyage are at hand.

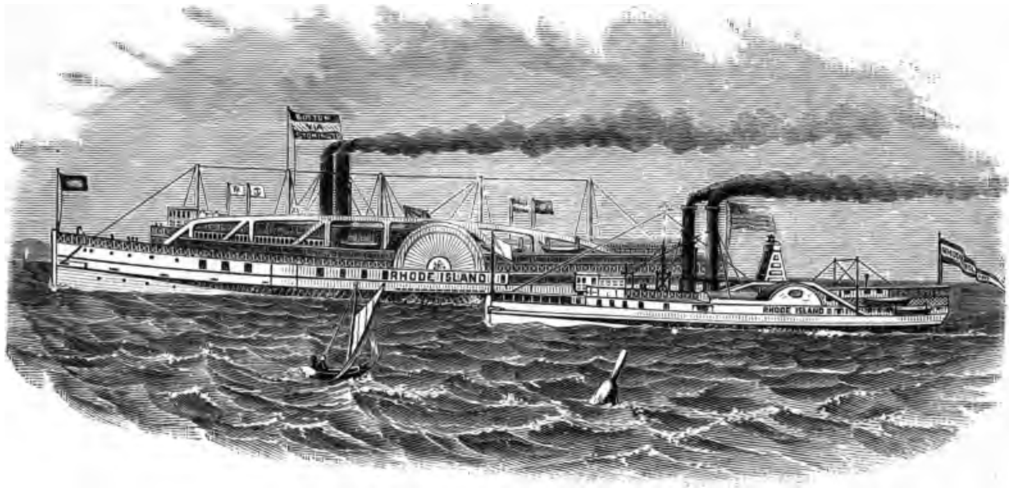
CHAPTER XIII.

Early navigation of Long Island Sound—Prohibitory laws against Fulton and Livingston—First steamboat to Providence and Newport—Description of early boats—Contrast with those of to-day—The old sailing packets—Steamboats at Boston and along the coast of Maine.

ALLUSION has been made in a previous chapter to the navigation of Long Island Sound by steamboats from New York under the grant of Fulton and Livingston.

For a time no opposition was made to the running of Fulton's boats, but at length the spirit of hostility broke out among the packet-owners and others, and in 1821 the Legislature of Connecticut enacted a retaliatory law that "no vessel bearing such a license [the monopoly of Fulton and Livingston] should enter any of the waters of that State." The Fulton and Connecticut were thus driven away and compelled to look elsewhere for occupation. The Fulton had been running between New York and New Haven, while the Connecticut made regular trips between New York and New London.

In August, 1821, the Fulton made an excursion from New York to Providence, carrying eighty



The Two Rhode Islands, 1836–1876.

passengers. Among them was Hon. John Quincy Adams, Secretary of State, who proceeded to Boston by land immediately on his arrival at Providence. The steamer left New York at 5 P.M. on Thursday, and arrived at Newport at 7:45 P.M. on Friday, thus occupying nearly twenty-seven hours for a voyage which is now made in seven or eight. At Newport, Bristol, and Providence the whole population came out to visit the boat, and there was the wildest excitement. The steamer reached Providence at nine o'clock on Saturday morning, and departed at two in the afternoon on the return trip. She was visited by thousands of people at Providence, and also at Newport. One of the passengers who kept a journal of the excursion, wrote as follows concerning it :

"We reached Newport at 8 P.M. on the return. It was quite dark, but the interest appeared to have increased rather than diminished. I took a station at the gangway to assist the inhabitants, and particularly the ladies, on board the ship, notice having been given that none but ladies would be allowed on board at first, and in the short space of twenty minutes I handed in three hundred and thirty-seven. I found that this number did not seem to have thinned the crowd in the least degree, and by nine o'clock there must have been on board upwards of six hundred ladies."

In the following June, the steamer Connecticut went from New York to Providence, being the first boat from the metropolis after the visit of the Fulton. The boats having been excluded from Connecticut ports, it was announced (in the Providence *Journal* June 3, 1822) that the steamers Fulton and Connecticut would make regular trips between Providence and New York, touching at Newport. A short time later the schedule was advertised; the boats were to leave Providence every Wednesday and Saturday at 6 A.M., and New York at 4 P.M. on the same days. Fare between New York and Providence ten dollars, and between Newport and New York nine dollars.

During the autumn of 1822, the rate of speed and number of passengers are recorded as follows: September 13th, Fulton, 27 hours from New York, 40 passengers; October 4th, Connecticut, 32 hours, 40 passengers; October 6th, Fulton, 24 hours, 26 passengers; October 10th, Connecticut, 18 hours, 35 passengers. The Fulton was hauled off in November, but the Connecticut made weekly trips until stopped by the ice. The following advertisement appeared after the withdrawal of the Fulton:

"The Connecticut will leave Providence every Tuesday evening to go down the river, in order to start from Newport at an early hour on Wednesday morning. It will therefore be necessary for passengers to be on board at Providence at ten in the evening."

The Fulton has been elsewhere described. The Connecticut was 150 feet long, 26 feet wide, and about 200 tons burthen. She had a "square" or cross-head engine, and is said to have cost $80,000. Neither she nor the Fulton had any upper saloon, state-rooms, or hurricane deck. Both boats had sails, to be used when the wind favored, and whenever a voyage was made without hoisting sail, the captain boasted of it as something remarkable.

Admiral Preble tells the following romantic incident of one of the trips of the Connecticut:

"As she approached Nyaot Point one June morning in 1823, two skiffs were observed making for the steamer. The occupants seemed to signal the vessel to stop, and such interest was aroused that Captain Bunker steered towards the foremost skiff and hailed her. There was returned no answer, but from the rear boat came oaths and shouts, from which those on the steamer gathered that the occupants of the foremost boat were runaways in pursuit of some Gretna Green. As their boat came within a few yards of the steamer, a young man looked up and said: 'Will you take us on board, sir?' An enthusiastic response from the passengers and a score of hands lent their aid. Captain Bunker seemed unconscious of what was going on, but tradition says that the instant the young man's feet touched the deck of the steamer, the engineer received an order to 'go ahead' with a suddenness that took away his breath; and in a very few seconds a wide stretch of water lay between the steamer and the empty boat."

But it must not be supposed that the Fulton was the first steamboat on Narragansett Bay. The experiment of Ormsbee and Wilkinson in 1792, which has been described, does not count in the history of the practical steamboat, and we hear nothing further of steam navigation in the waters once ruled by King Philip until 1817. In May of that year the steamer Firefly (Captain Smith) arrived at Newport in twenty-eight hours from New York. She had experienced a rough sea while rounding Point Judith, which came near sending her to the bottom. She was intended as a regular packet between Providence and Newport, and made her first trip from the latter to the former city on the 28th of May, 1817, being three hours on the way. She arrived about noon, and as her coming had been announced by a sloop, the wharves and banks of the river were crowded with people anxious to see her.

Her dimensions are not given, but she is described as "an ugly little thing, full of machinery, awkward in her motions, and with a terrible wheeze." On the 28th of June, the Governor and his staff went in the Firefly from Providence to Newport, to meet President Monroe, and escort him to Providence. The President boarded the boat at Bristol, and the Firefly with her distinguished passenger reached Providence about nine in the evening. July 26th she made a "cherry excursion" to Fall River, at two dollars a head for fare and dinner.

The opposition that Fulton had encountered when he started the Clermont was shown to the Firefly by the packet-men engaged in the trade between Providence and New York, with the exception that no attempts seem to have been made to destroy the innovation by running her down. Any fast sloop, with a favorable wind, could beat her, even though she spread the huge square-sail with which she was provided. The packet captains used to stand on the Firefly's wharf at Providence, just before she started, and offer to carry passengers to Newport for twenty-five cents in case they arrived there ahead of the Firefly, and for nothing if they were beaten by her. By this kind of opposition they rendered her occupation unprofitable, and in less than four months she retired from the regular passenger business between Providence and Newport, and devoted her energies to excursions.

The packets of those days were finely-modelled sloops, of from seventy to one hundred tons measurement, and had comfortable cabins for passengers. One of them, The Huntress, occasionally made the voyage between New York and Providence in eighteen hours, but sometimes, when adverse winds blew, she was a week on the way. Fare, inclusive of meals, was ten dollars, and the meals included liquid stimulants during breakfast and dinner. There was a weekly service of packets each way, and the departure of a packet from Providence was as serious an affair as is that of an ocean steamer to-day. Passengers were accompanied on board by their friends, there were solemn leave-takings with copious tears, and just before casting off the captain brought out his decanters, and everybody was asked to drink to the success of the voyage.

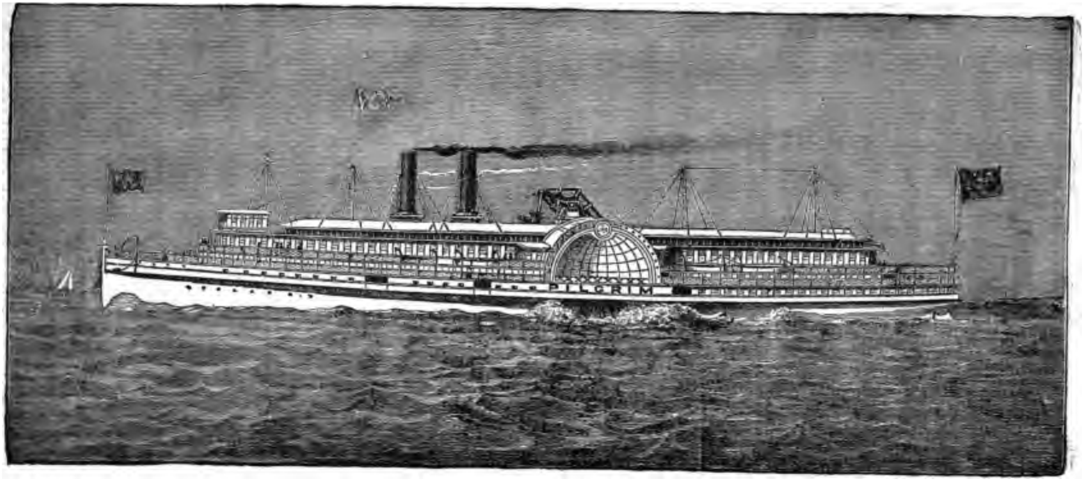
The packet captains opposed the Fulton and Connecticut in 1822 and 1823, but their opposition did not succeed as in the case of the Firefly. Steam navigation between Narragansett Bay and New York was firmly established and has been maintained ever since. As time has rolled on the steamers have increased in size and carrying capacity; contrast with the Fulton and Connecticut the Bristol and Pilgrim of the present Fall River line, which perform a daily service each way between Fall River and New York throughout the year, and an extra service daily in summer between New York and Newport. They may be regarded as the best types of steamers intended for combined inland and coast navigation, both in their construction and the elaborate character of their fittings throughout.

The Bristol was built in 1867, and her gross measurement is 2,962 tons; she is 373 feet in length, 83 feet beam over all, and has 16 feet depth of hold. Her machinery was built by John Roach & Son, and her hull by Wm. H. Webb.

The Pilgrim was built at Chester, Pennsylvania, in 1882, and the following are her principal dimensions: Length on deck, 390 feet; beam of the hull proper, 50 feet; beam over guards, 87.6 feet; depth of hold proper, 18.6 feet; depth from floor to top of dome, 60 feet; measurement, 3,483 registered tons. Her motive power consists of a vertical beam engine, with a cylinder 110 inches in diameter; stroke of piston, 14 feet, working under a maximum steam pressure of 50 pounds to the square inch. She has twelve boilers made of steel, developing in all 5,500 horse-power.

The hull of the Pilgrim is built on the longitudinal bracket system throughout; that is, she is a ship within a ship, and has 103 water-tight compartments. It would be impossible to sink her by staving in her bottom. Twenty-five feet from her stem is the water-tight collision bulkhead, fifty feet abaft the stem is another bulkhead, and thirty feet forward of her stern is another bulkhead, all of iron. Her engines and boilers are enclosed in iron bulkheads, rendering it impossible for fire from boilers or kitchen to reach any other part of the boat. The introduction of electricity has reduced the chances of fire to the most infinitesimal point, there being no fire in any part of the vessel except in the boiler-room and kitchen.

The electric "plant" on the Pilgrim is Edison's, and consists of 912 lamps, one "L" and two "K"



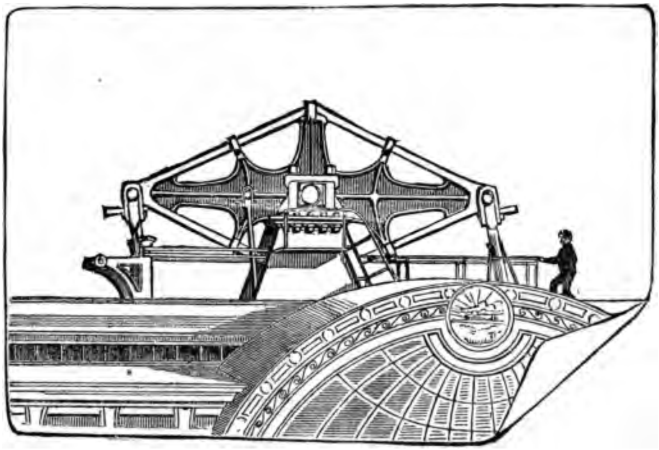
The Pilgrim.

dynamos, with a capacity of 11,382 candle-power, and two Armington and Sims engines, one 8½ x 10 "B" engine, and one 9½ x 12 "C" engine, belted direct to the dynamos. Steam is furnished by a special boiler of 150-horse power, with 80 pounds pressure, and in case of necessity connections can be made with the main or donkey boilers.

The following is condensed from a description in "The Fall River Line Journal":

"The quarter-deck is 29.4 feet deep, 50 feet wide, and 10.8 feet in height. Its floor is inlaid in cherry and maple, and furnished with richly carved mahogany library chairs upholstered in maroon leather. Its after end is the ladies' parlor bulkhead, and its forward confines is marked by the grand saloon vestibule. Its sides are embellished with alternate panellings of exquisite tintings and the richest of mahogany. The decorated panels in the wall are of the Tuscan style, with a rich blending of bronze and burnished gold. The mahogany panels are of the richest selections as to grain and color, and are set with plate-glass mirrors. A jewelled electrolier adorns the quarter-deck, and the emerald, ruby, sapphire, garnet, and amethyst blend their rich tints under the mellowing light of electricity. The semicircular vestibule leading to the grand staircase has four large doors. Through these doors you ascend to the grand saloon, or, passing beneath the staircase, the descending stairway leads to the dining saloon. The staircase is of the richest mahogany, is broad, of easy tread and attractive design, and leads up to a landing where a very heavy plate mirror gives back a most pleasing effect. Stairs lead from the landing to each side of the saloon.

"Before we leave the deck let us pass aft through the saloons leading from the quarter-deck. The after one is the ladies' saloon. Beneath this saloon, reached by a staircase in the centre, is the ladies' cabin which is richly carpeted, and is well lighted and ventilated by large dead-lights in the transom. From this cabin is a passage-way through the iron bulkhead and into the dining saloon. Ascending to the main deck, passing through the after



Walking-Beam of the Pilgrim.

ladies' saloon, we enter the ladies' parlor, which is 70 feet long and the width of the boat (excepting the guards), and contains 33 state-rooms and 6 alcove passage-ways to the guards. The parlor is a most luxuriantly fitted-up apartment, with Wilton carpets, carved mahogany furniture covered with maroon velvet, gorgeous electroliers, rich centre tables and "conversation" chairs. The state-rooms are large, lofty, and exquisitely upholstered and carpeted. To outfit the Pilgrim 6,000 yards of carpeting have been used.

"The grand saloon is 320 feet in length. Its dome roof is 20.6 feet from the saloon-deck, and is 280 feet long. The sides of the saloon are 9.3 feet high, and of the gallery 6.7 feet high. This grand apartment will hold, with its gallery-balcony, her allowance of 1,400 passengers, without crowding, a gathering which would require over 23 ordinary railway cars to seat. The general style of finish on the quarter-deck is carried out in the grand saloon, the pilasters being decorated with ornamental stucco work, gilded and copper-bronzed, and tinted in the most chaste colors. The ceiling overhead and under the gallery-deck is frescoed in parti-colors. In this grand saloon are 103 state-rooms, seven bridal rooms, and two family bridals, with a connecting room. The bridal rooms each have folding bedsteads, so that the room is a drawing-room until the time of retiring. Every state-room is furnished in black walnut, with an electric light, electric call-bell, wash-stand with handsomely decorated basin and toilet set, lace curtains and berth coverlets of handsome design. Many of the rooms have folding upper berths. The Pilgrim has sleeping accommodations for 1,200 passengers.

"The gallery-deck contains 80 state-rooms for passengers; the president's room, nearly treble the size of the ordinary rooms, with bathroom attached; the captain's room, two rooms for the pilots, and a room for the quartermasters. Forward of this is the pilot-house, finished in cherry, with inlaid floors.

"The grand dining hall and its cabin extend from the engine bulkhead to the after watertight bulkhead, and contain 27 state-rooms, with three berths in each room. The dining hall has 16 tables, capable of seating 170 persons. It is a spacious apartment, airy, and lighted profusely. Forward of this saloon is the servants' quarters, where 54 men are berthed nightly."

Contrast the magnificence of the Pilgrim with the meagre accommodations of the Fulton and Connecticut, and then bear in mind that the price of passage to-day is less than half the cost of a ticket in 1822. Competition occasionally brings it to a very low figure. Tickets are sometimes sold for a continuous passage between Boston and New York for one dollar, including a berth in the general cabin, and the winter rate is usually three dollars.

Other steamboat routes on Long Island Sound are from New York to Stonington, from New York to New London, and another by propellers from New York to Providence. Then there are routes from New York to New Haven, Bridgeport, Norwalk, and other smaller ports on the north side of the Sound, as well as to several places on the southern shore. All these lines have histories, but none of them are so closely connected with the inauguration of steamboating as are those whose details have just been given.

An incident of 1829 is worthy of record here. At a meeting of the directors of the Chancellor Livingston Steam Packet Company in that year a resolution was adopted prohibiting the stewards of the boats from putting decanters of brandy and other spirits on the table. There was great indignation at their action. The passengers held meetings and protested, and some of the newspapers sustained them. The directors found it necessary to publish a letter in defence of the resolution, in which they set forth that they were "not influenced by petty motives of economy or gain, but hoped to do a little to aid the cause of reform." The letter closed in the following words:

"The tables are now supplied with red wines of good quality and pleasant flavor, as well as a good tendency in its effects upon those who may be affected by the motion of the boat. In addition to all this, whenever any person may choose to order brandy or spirits from a belief of their necessity, it will be immediately and cheerfully supplied from the bar, and the gentleman will hear no more about it unless he pleases."

This concession to the growing feeling in favor of temperance was not long in finding general approval, and no further complaint was heard from the old-time drinkers.

From Narragansett Bay, our next step eastward will be to the Kennebec, which was ascended in 1816 by the steamboat Alpha—a long, narrow, flat-bottomed craft of fifteen tons, propelled by a screw in the stern. She was built by Jonathan Morgan, of Wiscasset, Maine, who had expected to make a fortune out of his invention.

According to the accounts which have been given, the Alpha was a strange affair. Her boiler was built of pine plank, hooped stoutly together with iron hoops, and about the size of a molasses cask, and with a fire-box of iron in its centre. The engine was connected to the propeller by an endless chain, but the power was insufficient to stem the current of the river at more than a snail's pace. The Alpha ascended the Kennebec to Augusta on her first trip. She landed at Hallowell, where many people visited her. When she left the wharf to continue her journey, she was carried down a considerable distance before she got sufficient headway to proceed on her course. Morgan's enterprise was unsuccessful, and after vainly trying to raise capital for a steamboat company, he turned his attention to other matters. His boat was sold by a constable of Wiscasset at "public vendue" for eighty-seven dollars, and her machinery was removed. The waggish purchaser converted the Alpha into a fishing-vessel, and is said to have renamed her the Omega.

The first advertisement of a steamboat in Maine is in the *Portland Argus*, of August 13, 1822, as follows:

"The steamboat 'Kennebec' will leave Union Wharf at four o'clock for North Yarmouth, to spend the day. Will return on Thursday to take passengers to the island as usual. If required, will stop at Week's Wharf to land and receive passengers. Will also, should sufficient number of passengers apply, go to Commencement the day preceding, and also on the day of Commencement."

A local poet of Portland thus writes concerning the steamboat;

"A fig for all your clumsy craft,
Your pleasure boats and packets,
The *steamboat* lands you safe and soon,
At Mansfield's, Trott's, and Brackett's."

The Kennebec was an old flat-bottomed craft, in which Captain Seward Porter had placed a steam engine of light power, in order to fit her for excursions in the bay. He made money by the enterprise, and early in 1824 went to New York to purchase a steamer of less modest aspirations. The following is from the *Portland Argus*, of July 8, 1824:

"The steamboat 'Patent,' Captain Seward Porter, arrived here yesterday in four days from New York, having touched at a number of places to land passengers. She is intended to ply between this place and Boston, is strong and commodious, and elegantly fitted for passengers. Her engine has been proved, is of superior workmanship, and propels the boat about ten miles an hour. From the perseverance of Captain Porter we have no doubt but he will meet with good encouragement, and find it profitable. We wish him every success."

The boat was described in a report to her stockholders as of two hundred tons burthen, and costing twenty thousand dollars. She had no hurricane deck, and was quite low in the water; her boiler and engines were below, and she had a heavy balance-wheel half above her deck, and an arrangement for disconnecting the machinery from the wheels. All her cabins were below, the ladies' cabin being at the stern, and entered by passing through the gentlemen's cabin. The *Boston Courier*, of August 12, 1824, mentions her arrival in seventeen hours from Portland, with seventeen passengers. Fare between Boston and Portland was five dollars, including meals, and it remained at that figure until reduced by competition. For some time boats carried passengers free between Boston and Portland, without charge for meals or lodging.

In 1826 there were three or four boats on the coast of Maine. One of them, the New York, was fitted with masts and sails like a brig, and was generally called "The Steam-brig." She was destroyed by fire in 1829, but happily without loss of life.

Steam navigation at Boston began in 1817 with the steamboat Massachusetts, of 230 tons measurement and 30-horse power. She was intended to run between Boston and Salem, and her owners had great hopes concerning her. She made a few trial trips in the latter part of June. On the fourth of July she left Salem at 8 A.M. and reached Boston at 11 A.M., her greatest speed being eight miles an hour. In the afternoon of the same day she took a party of ladies and gentlemen down the harbor—unquestionably the first fourth-of-July steamboat excursion ever known to the Bostonians.

Her machinery was defective, and on two or three occasions she broke down when on excursions, and her passengers had to find their way back in other ways than by steam. She ran during the summer at a heavy loss. In the autumn she was sent south to be sold and was wrecked on the voyage. The stage companies are said to have been active in their opposition to her, and much of the distrust which existed in the public mind concerning the Massachusetts was fostered by them.

In spite of the failure of the Massachusetts, another and larger boat—the Eagle—ran in Boston harbor as an excursion boat in 1818, and later she was plying between New Bedford and Nantucket. She seems to have been more successful than her predecessor, and from that time onward Boston was never unprovided with steam facilities, unless at rare periods, or when the harbor was sealed with ice. A few years after the advent of the Eagle, boats were sent from New York to ply between Boston and Portland. The service between these ports was at first weekly, then semi-weekly, and afterward daily each way. In time it was extended to Eastport, and between 1848 and 1850 the coast of Maine was provided with frequent and rapid communication with the New England capital.

CHAPTER XIV.

Early steamboats on the Clyde, Thames, Humber, and in other British waters—The Comet and Enterprise—First steamboat at London—Opposition of the Watermen—Oldest steamboat in existence—Steamboats in Canada and Java in 1809 and 1810.

WE will now leave American waters, and, with a single bound, carry ourselves across the Atlantic, and back to a time before the death of Fulton. Steamers are not yet traversing the ocean, and our journey of three thousand miles over the broad waters will be made by sail in the old way, or on the speedier wings of imagination.

Allusion has been made in Chapter V. to the experiments of Miller, Taylor, and Symington in Scotland, and to those of the Marquis de Jouffroy in France, in the latter part of the eighteenth century and the beginning of the nineteenth. Another inventor deserves mention here, though he never seems to have gone so far as to make a working model of his proposed vessel.

According to the "Repository of Arts," volume x., one Edward Thomason laid before the British Admiralty, in 1796, a detailed description of a fire-ship for naval purposes. It had vertical wheels at the sides, propelled by steam-engines, and was intended to move without any person on board in whatever direction it was started. Thus propelled, it was to enter an enemy's harbor, and, by means of clock-work, "explode several barrels of gunpowder, by which the enemy's shipping would be set on fire and destroyed." The same idea is carried out to-day in the form of torpedo, which is directed from shore or from a ship by means of electricity, and exploded through the same agency.

The English *Monthly Magazine* for July, 1797, contains the following:

"Lately the Newton-Common, in Lancashire, a vessel heavily laden with copper slag, passed along the Sankey Canal without the aid of haulers or rowers, the oars performing eighteen strokes a minute by the application of steam only. After a course of ten miles, the vessel returned the same evening by the same means to St. Helen's, whence she had set out. This ingenious discovery by the original form and motion of the oars may be ranked among the most useful of modern inventions, and, in particular, promises the highest benefits to inland navigation."

The same publication, in 1801, gives an account of an experiment on the Thames in January of that year, by Messrs. Hunter & Dickinson, for propelling a boat by steam. It says: "The performance was very creditable to them, and exceeded any thing ever before accomplished; the vessel was moved at the rate of three miles an hour through the water." Another experiment in July of the same year moved a barge at the rate of two and a half miles an hour.

The boat of Lord Dundas, mentioned in Chapter V., appears to have been the first steam tow-boat ever *intended, built, and used* for towing, and she fell just a little short of being a practical success. Her machinery is still in existence, and was exhibited in London a few years ago.

Nothing further seems to have been done in the interest of steam navigation in Great Britain until ten years after the failure of the Charlotte Dundas and five years after the Clermont had successfully plowed the waters of the Hudson, and taken her place as a regular packet between New York and Albany. Henry Bell, of Helensburgh, a watering-place on the river Clyde, where he kept a hotel and bathing establishment, opened a correspondence with Mr. Fulton, and, on learning of the success of steam navigation in America, determined to establish it in Scotland.

Bell caused several models of a steamboat to be made, and finally obtained one that suited him. He contracted with John Wood & Co., ship-builders at Glasgow, to build a steam-vessel after the model he selected; it was forty feet long and ten feet six inches beam, and was propelled by a Watt engine on the "bell-crank" principle, as it was then known. The fire was on the outside of the boiler, and the furnace was inclosed by brick-work to prevent the destruction of the boat by a conflagration. The boiler was on one side of the engine, and the funnel was bent so as to carry it up to the centre of the boat, where it was utilized as a mast for spreading a sail when the wind favored.

The boat was named the "Comet," not in consequence of her meteoric speed, but because she was built in 1811, which has been mentioned heretofore as the year of the comet. Her speed was about five miles an hour; she was of twenty-five tons measurement, and her engine is said to have been of three-horse power. She made her first trip in January, 1812, and was profitably employed as a passenger boat during the entire summer. The following is Mr. Bell's advertisement concerning her:

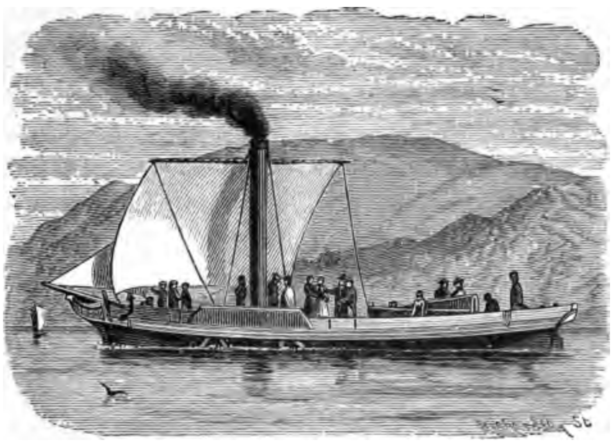
"STEAM PASSAGE BOAT—The Comet—Between Glasgow, Greenock, and Helensburgh; for passengers only. The subscriber having at much expense fitted up a handsome vessel to ply upon the river Clyde between Glasgow and Greenock, to sail by the power of wind, air, and steam, he intends that the vessel shall leave the Broomielaw on Tuesdays, Thursdays, and Saturdays, about mid-day, or at such hour thereafter as may answer from the state of the tide; and to leave Greenock on Mondays, Wednesdays, and Fridays, in the morning, to suit the tide.

"The terms are for the present fixed at 4*s*. for the best cabin and 3*s*. for the second; but, beyond these rates, nothing is to be allowed to servants or any other person employed about the vessel.

"The subscriber continues his establishment at Helensburgh Baths the same as for years past, and a vessel will be in readiness to convey passengers in the Comet from Greenock to Helensburgh.

"Passengers by the Comet will receive information of the hours of sailing by applying at Mr. Housten's office, Broomielaw, or Mr. Thomas Blackney's, East Quay Head, Greenock. HENRY BELL.

"HELENSBURGH BATHS, Aug. 5, 1812."



The "Comet," 1812.

Greenock is about twenty-seven miles from Glasgow by the river, and as the Comet made only three round trips weekly between the two places, she could not have been hard pushed. James Watt, the inventor of the form of the steam-engine that bears his name, was born at Greenock, and in 1838 a marble statue of him was erected there by public subscription. Helensburgh is nearly opposite

Greenock, and is now connected with it by a steam ferry.

Admiral Preble says the Comet was wrecked in 1825 on a return trip from the Western Highlands, and many of her passengers were drowned. He adds that Bell became as great a wreck as his vessel, and the Clyde trustees, out of gratitude, settled upon him an annuity of one hundred pounds sterling, which he enjoyed until his death in 1830.

As the success of the Clermont led to competition in New York waters, so did that of the Comet on the Clyde. Bell had employed an engineer named Thompson to assist in making the plans for the Comet; they quarrelled, and Thompson engaged Mr. Wood, the builder of the Comet, to construct another boat, which was fifty-one feet keel, twelve feet beam, and five feet deep. Her measurement was about thirty-three tons, and her engine ten-horse power. She was named the Elizabeth, and her performance is thus described by her owner:

"The Elizabeth was started for passengers on the 9th of March, 1813, and has continued to run from Glasgow to Greenock daily, leaving Glasgow in the morning and returning the same evening. The passage, which is twenty-seven miles, has been made, with a hundred passengers on board, in something less than four hours, and in favorable circumstances in two and three quarters. The Elizabeth has sailed eighty-one miles in one day, at an average of *nine miles an hour*. The Elizabeth measures aloft fifty-eight feet; the best cabin is twenty-one feet long, eleven feet three inches at amidships, and nine feet four inches aft, seated all round, and covered with handsome carpeting. A sofa clothed with maroon is placed at one end of the cabin, and gives the whole a warm and cheerful appearance. There are twelve small windows, each finished with maroon curtains, with tassels, fringes, and velvet, cornices ornamented with gilt ornaments, having altogether a rich effect. Above the sofa there is a large mirror suspended, and on each side bookshelves are placed, containing a collection of the best authors, for the amusement and edification of those who may avail themselves of them during the passage. Other amusements are likewise to be had on board.

"The engine stands amidships, and requires a considerable space in length and all the breadth of the vessel. The forecastle, which is rather small, is about eleven feet six inches by nine feet six inches; not quite so comfortable as the after one, but well calculated for a cold day, and by no means disagreeable on a warm. All the windows in both cabins are made in such a way as to shift up and down like those of a coach, admitting a very free circulation of fresh air. From the height of the roofs of both cabins, which are about seven feet four inches, they will be extremely pleasant and healthful in the summer months for those who may favor the boat in parties of pleasure.

"Already the public advantages of this mode of conveyance have been generally acknowledged; indeed, it may without exaggeration be said that the intercourse through the medium of steamboats between Glasgow and Greenock has, comparatively speaking, brought those places ten or twelve miles nearer each other. In most cases the passages are made *in the same time as by the coaches;* and they have been, in numerous instances, done with greater rapidity. In comparing the comfortableness of these conveyances, the preference will be given decidedly to the steamboat. Besides all this, a great saving of expense is produced; the fare in the best cabin being only four shillings, and in the inferior one, two shillings and sixpence, whereas the inside of a coach costs not less than twelve shillings and the outside eight shillings."

The greater speed of the Elizabeth compared with that of the Comet caused her to be the favorite, and she is said to have been much more profitable to her owners than was her predecessor. One account says the Comet was never a remunerative boat, as the competition began before she had made any appreciable return for her cost.

A third steamer, the Clyde, was built the same year (1813) by Mr. Wood for Mr. Robinson, of Port Glasgow. She was 76 feet long on deck, about 14 feet beam, measured 75 tons, and had an engine of 14-horse power. Her speed is said to have been six miles an hour.

While the Clyde was on the stocks, a joint-stock company for steam navigation—the first ever organized in Great Britain—was formed at Glasgow for the transportation of both passengers and freight. Its first boat was the Glasgow, of 72 feet long, 15 feet beam, 74 tons measurement, and with engines of 16-horse power. Afterwards she was lengthened by adding five feet to her bow which increased her speed considerably. She was launched late in 1813 and was not in service until the following year.

The next Clyde-built steamer was the Dumbarton Castle, in 1815, 81 tons, 107 feet long, 17 feet beam, and engines of 32-horse power. She ran to Rothesay, and in the following year went through the Kyles of Bute and up Lochfyne to Inveraray, making the trip in sixteen hours, which was then considered something extraordinary.

The Britannia, somewhat smaller than the Dumbarton Castle, was built in 1815, and the Rob Roy, also smaller, in 1818. The latter was the first steamer to cross the Channel to Belfast. The Robert Bruce, 90 tons measurement, 94 feet long, 18 feet beam, and 11 feet deep, was built in 1818, and was the first steamer to run between Glasgow and Liverpool.

From this time forward the business of building steamers on the Clyde progressed rapidly. At present a considerable part of the river front between Greenock and Glasgow is occupied by shipyards, and as many as two hundred steamers have been built there in a single year. In the foundries and machine-shops of Glasgow from five to eight thousand men are employed in the construction of marine steam-engines, and there is a proportionate number in the ship-yards where the hulls are built. The Clyde ship-yards may justly be considered the first in the world. All the fine packets of the

Cunard Company were built there, and so were many other steamers that have made a reputation for speed and safety.

With the establishment of lines from Glasgow to Belfast and Liverpool we will leave the Clyde for the present and turn our attention elsewhere.

In 1818 a steamer was launched at Manchester and another at Bristol; in 1814 one was in operation on the Humber, and in December of that year the first steamer on the Thames gave the initial turn of her wheels on the canal at Limehouse. The boatmen made a keen opposition to the innovation, and she was taken elsewhere after a few weeks. But very soon other boats were running at London, and the Company of watermen found it useless to try to stop them.

Extracts from the papers and other publications of the time show that the builders of boats were everywhere busy. By the beginning of 1815 there were five steamboats on the Thames, the best of them being the Thames, of fourteen-horse power; she was built at Glasgow and was originally called the Argyle, her name being changed when she was sent to London.

Cleland's "Annals of Glasgow" says that between the years 1812–15, inclusive, twenty steamboats of various sizes were built at Glasgow and its vicinity. Of these boats, the Margary went to London in 1814, the Argyle in 1815, and the Caledonia and Greenock in 1816. Two of the steamboats ran regularly between London and Margate during the bathing season.

The *British Naval Chronicle* for July, 1815, says: "The 'Thames' steam yacht is said lately to have accomplished a voyage of fifteen hundred miles. She twice crossed St. George's Channel, and sailed round Land's End, and is the first steam vessel that ever traversed those seas. The advantages of a vessel enabled to proceed either by sail or steam or both united, must be sufficiently obvious, and especially in the certainty of reaching its place of destination in a given time."

During her voyage the Thames had a narrow escape from being wrecked. She was being driven on a lee shore by a strong gale. Her captain put her head to windward and steamed directly into the teeth of the gale at the rate of three miles an hour, thus saving the boat. She stopped at Dublin and Portsmouth. At the latter place she attracted much attention, and so numerous were the boats around her, that it was necessary for the captain of the port to send a guard to preserve order. A naval court-martial adjourned its session in order to visit her, and one day (the 10th of June) the port-admiral sent his band and a guard of marines on board, and followed soon after in person accompanied by three admirals, eighteen post-captains, and a large party of ladies. With her distinguished visitors the boat made an excursion around the harbor and to the Isle of Wight. The naval officers expressed themselves highly pleased with the steamer, and some of them predicted that steam would soon be employed for propelling ships of war.

A log of the voyage was kept by Mr. Weld, a passenger from Dublin to London, and from this log an account was condensed and published in *Chambers's Journal*, in April, 1857. Mr. Weld says the boat steamed seven hundred and fifty-eight miles in one hundred and twenty-one and a half hours, with an expenditure of one ton of coal for every hundred miles. Whenever they passed a ship the sailors mounted the rigging or crowded the rail to look at the novelty, and sometimes their remarks were the reverse of complimentary. The harbor-master of Plymouth had never seen a steamboat, and was as much astonished at the strange vessel as a child with a new plaything. In ascending the Thames they passed every thing in the river, including all the fast-sailing pleasure boats, East Indiamen, and other craft.

Sir Rowland Hill, who obtained celebrity for his reforms in the post-office, mentions in his autobiography the steamboat plying between London and Margate in 1815. On the third of July of that year he and his brother "went to see the steamboat come in from London; generally performing the voyage in about twelve hours. It is surprising," he continues, "how most people are prejudiced against this packet. Some say that it cannot sail against the wind if it is high, but when it entered the harbor at Margate, the wind and tide were both against it, and the former rather rough —yet I saw it stem them both. There was a great crowd and much enthusiasm, though carpers predicted failure and sneered at the 'smoke-jacks.'"

Probably the oldest existing steamboat in the world, though not in use, is the Industry—the seventh steamer on the Clyde, which was built in 1814. She was fifty-four tons measurement, and ran successfully for some years. By an accident she was sunk in the East India docks at Greenock, where she lay until 1872, when she was floated and restored to her old condition as nearly as possible. In 1876 she was presented by her owners, Steele & Company, to the Glasgow Chamber of Commerce, to be preserved as a memorial of the early days of steam navigation in the United Kingdom. As before stated, the oldest steamboat engines in existence are those of the Charlotte Dundas constructed in 1801, and of Col. Stevens' boat at Hoboken, built and operated in 1804.

Before the establishment of steam navigation on the Clyde and in other British home waters, steamboats were in successful operation in two of the British colonies on opposite sides of the world from each other. In 1809 the steamboat Accommodation made the passage from Montreal to Quebec in sixty-six hours, of which thirty hours were passed at anchor. She was 85 feet long on deck, 75 feet keel, and had berths for twenty passengers in her cabins. The price of passage was nine dollars up the river and eight dollars down, which included meals and lodgings. Her first trip was made with ten passengers.

In the spring of 1813 a second boat, the Swiftsure, was launched on the St. Lawrence, and began running between Montreal and Quebec. Her measurements were 130 feet keel, 140 feet deck, and 34 feet beam, and she made the voyage from Montreal to Quebec in twenty-two hours, in face of a strong wind from the east. That her owners hesitated to defy the breezes is shown by her advertisement in the Quebec *Mercury*, which announced that the boat would "sail as the wind and passengers may suit."

In 1811 Java was in the hands of the English, where it remained until 1816, when it was ceded to Holland, which formerly owned it, and has remained in Dutch control ever since. In the latter part of 1810, or early in 1811, some English merchants at Batavia built a steamboat, the "Van der Capellan," which they leased to the government, at the handsome remuneration of ten thousand dollars a month. She was in that employ for two years, and was of great service in the transportation of soldiers and war material from one part of the island to another. After the expiration of the government contract, she was in private hands for some years, and again as a government boat. She was used as a dredging boat about 1822, and later as a gunboat, and was lost in a gale in the Java seas after a career of twenty years.

CHAPTER XV.

Further history of steam navigation in foreign waters—Steamers in Russia, France, and other countries—First steamer on Lake Baikal, Siberia—Inauguration of steam-towing—Description of a steam-collier—Steam navigation to Belfast, Dublin, and Havre—New steamers between Holyhead and Dublin—David Napier—Present steam fleet of Great Britain.

ACCORDING to the "Dictionnaire Larousse," steamboats were introduced into France in 1816, but their success was not sufficiently demonstrated at the outset, and steam navigation did not begin to develop fairly until 1825. The same dictionary awards to Fulton the honor of building the first successful steamboat, and does not seek, like most of the English encyclopedias, to ignore that inventor and give the distinction to a Briton.

Steam navigation was adopted in Russia soon after its success on the Clyde. Mr. Baird, an English engineer in the employ of the Russian Government, built a small steamboat of four-horse power in 1815, with which he made a trip from St. Petersburg to Cronstadt and back without accident. In 1816 he built a larger boat of twenty-horse power and fitted for carrying passengers between those cities, and in the summer of that year it was in successful operation.

Russia is the land of monopolies, and Mr. Baird received from the government a monopoly for twenty years on the waters around St. Petersburg for all steamboats for commercial purposes. In the same year the government built a steamboat of thirty-two-horse power at its yard at Ishora. It was designed as a transport, and was appropriately named the "Rapid," though doubtless in these days it would be called "Slow." Several other steam transports were built at this and other yards, and in 1826 the Russian Government built its first steam gunboat. Steamboats were placed on the rivers of Russia at varying dates between 1820 and 1840. In 1844 there were four steamboats on the Caspian Sea and others on the Black Sea; most of them, if not all, having engines from the Baird works at St. Petersburg.

In 1843 an enterprising merchant of Irkoutsk, Eastern Siberia, built a steamboat for the navigation of Lake Baikal. The hull was built on the shore of the lake, while the engines and boilers were made at the Baird works and transported overland four thousand miles from St. Petersburg in wagons and sleighs. Mr. Baird sent an engineer to superintend the work, but all the labor on the hull, and of putting the engines in place, was performed by Siberian peasants who had never seen any thing of the kind. The boat crossed the lake for the first time in a strong gale, which she faced so boldly as to astonish everybody who looked at her from the shore. When the natives on the eastern shore saw the monster approaching they fled in dismay, and could not for some time be induced to come back. The boat was of thirty-two-horse power, and was called the Emperor Nicholas.

Returning to Liverpool and to 1816, we find that the first steam ferry-boat built there was in that year, and was called the Etna. It is probable that her construction was begun in the previous year, as the records show that she commenced her services in April, 1816, between Liverpool and Traumere. She was sixty-three feet long and twenty-eight feet broad; she had a paddle-wheel in the centre, and her ends were connected by strong beams. The Etna may be regarded as the pioneer of the vast fleet of small steamboats that ply on the Mersey between Liverpool, Birkenhead, and other points, and render the passenger arriving from America exceedingly miserable with their lack of accommodations. Landing or embarking at Liverpool is a wretched beginning or ending of a transatlantic voyage. The steam-tenders provided by the great companies are a disgrace to modern civilization and its locomotive triumphs. Save in the matter of speed and dimensions, these Liverpool boats of to-day are probably no improvement upon the Etna and her immediate followers.

In the same year that the Etna began her work in the Mersey the English Channel was crossed from Brighton to Havre by steam for the first time. The feat was accomplished by the steamboat Majestic, which was built at Ramsgate and had engines of twenty-five-horse power. She carried two hundred passengers, who must have been packed very closely, but they seem to have enjoyed their journey, which was made without accident. The Majestic passed several of the sailing packets, and reduced the time required for the trip more than one half. This single boat demonstrated the superiority of steamboats over sailing packets, and in a very few years the passenger business had gone over to the steamers, with the exception of a few conservatives who had fears regarding the safety of boats with boilers and huge fires.

In October, 1816, the ship Harlequin was towed out of the Mersey by the steamer Charlotte, which had been built as a passenger boat to ply between Liverpool and Eastham. A Liverpool tradition says the Charlotte was the first steam tow-boat, and there is no positive proof to the contrary. It will be remembered that the steamboat of Jonathan Hulls, in 1736, and the Charlotte Dundas, in 1801, were intended for towing purposes. The former never went beyond the plans of the architect, and the latter was abandoned as a failure.

The inauguration of steam towing has had several claimants, and it is not very easy to reconcile them. Mr. Rennie, who planned the breakwater at Plymouth, was an "advising engineer" to the Admiralty and an early advocate of the application of steam-power to ships of war. In 1819 he endeavored to demonstrate the feasibility of his theories by hiring, at his own expense, the steamer Eclipse, and employing her to tow a seventy-four-gun ship (the Hastings) from Woolwich to Gravesend. The feat was successfully accomplished, as the Hastings was moved against the tide without difficulty. Several naval officers who had previously opposed the application of steam to naval vessels, or had remained neutral on the subject, now came forward to advocate it. Among them were Lord Melville and Sir George Cockburn.

Another claimant for the honor was Joseph Price, a glass manufacturer of Newcastle-on-Tyne. In 1838 he delivered an address, from which the following is an extract:

"In July, 1818, I conceived that good might be done with steamboats by towing vessels to sea. In furtherance of my idea, I applied to the late Mr. Robson, Wharfinger of Newcastle, for leave to try an experiment with one of his loaded vessels, which was granted. I gave notice to Captain Copeland, of the 'Friends' Adventure,' Hull trader, to have all ready from an hour to an hour and a half before high water. At the time appointed I requested him to throw a line on board the steamer.

The tide was against us the first three miles. Every thing answered as well as I could wish, and the vessel was towed two miles over the bar in two hours and ten minutes, a distance of thirteen miles, the wind against us all the way. This was the first time a sailing-vessel was ever towed by a steamboat. The public did not at first appreciate my endeavors for expediting the sailing of ships in adverse winds; on the contrary, I was told I had ruined the port, I continued my two steamboats, the Perseverance and the Eagle, in this employ, with little benefit to myself, for my captains were so timorous they would not stir but in moderate weather. They once had an offer to tow two ships with one boat; they would on no account undertake so heavy a task."

Another account of steam towing at Newcastle says:

"Mr. Price's example led the way to general traction by steam. After a considerable interval other owners of steamboats saw the advantage of the towing system, and employed theirs in a similar manner, receiving pay according to the depth of water the sailing-vessels drew. The advantage to the ship-owner was great. Previously no vessel over two hundred and forty tons register ever attempted to come up to Newcastle. After the introduction of the towing system vessels of four hundred tons were brought up, and vessels that previously averaged only eight voyages in the year between the Tyne and the Thames, were able to average thirteen voyages, thereby keeping the coal market regularly supplied and preventing those great fluctuations in prices which formerly had such a serious effect in increasing the miseries of the poor."

According to Mr. Price the towing system was adopted between Gainsborough and Hull in 1821, and four years later at Liverpool. Afterwards it was adopted at Montreal, and he records that a large steamboat towed three or four ships to that city from Quebec in forty-eight hours. Before that time sailing vessels between Quebec and Montreal required two or three weeks for the voyage.

The achievements of Mr. Price were recorded by a local poet of Newcastle in the following lines:

> "Steam neist cam' puffin' into play
> And put an end to rowin';
> When Price said, in his schemin' way,
> 'Let 's try the chep at towin'.'"

Steam was not satisfied with towing the Newcastle colliers in and out of port. A few years after the successful experiment of Mr. Price, a coal vessel was fitted with a steam-engine and made the trip to London and back so quickly as to astonish the owners of sailing craft. The first regular steam collier was built in 1844, and was bark-rigged. Since then steam colliers have been built in considerable numbers, and at present they have nearly driven the sailing-vessels out of the business. The colliers are built with more regard to capacity than speed. Few men are required for their management, and the cost of the fuel consumed on the voyage is more than compensated by the great saving in time and the consequent transporting ability of a vessel in a given number of months.

One of the latest of the steam colliers is the King Coal, which cost, when ready for sea, seventy-five thousand dollars, and may be taken as a type of this kind of vessel. She can carry one thousand tons of coal, and has arrangements for ballasting herself with water when she has no coal on board. Her speed is from eight and a half to nine and a half knots an hour—the former being her progress when fully laden and with the wind against her. Her engines are ninety-horse power, nominal. All the work of hoisting sails and lifting anchors is done by steam-power, and her entire complement of men is seventeen. There is no accommodation for passengers, with the exception of four berths in the captain's saloon for persons who may be interested in the cargo. They mess with the officers during the voyage, and are not provided with a separate table.

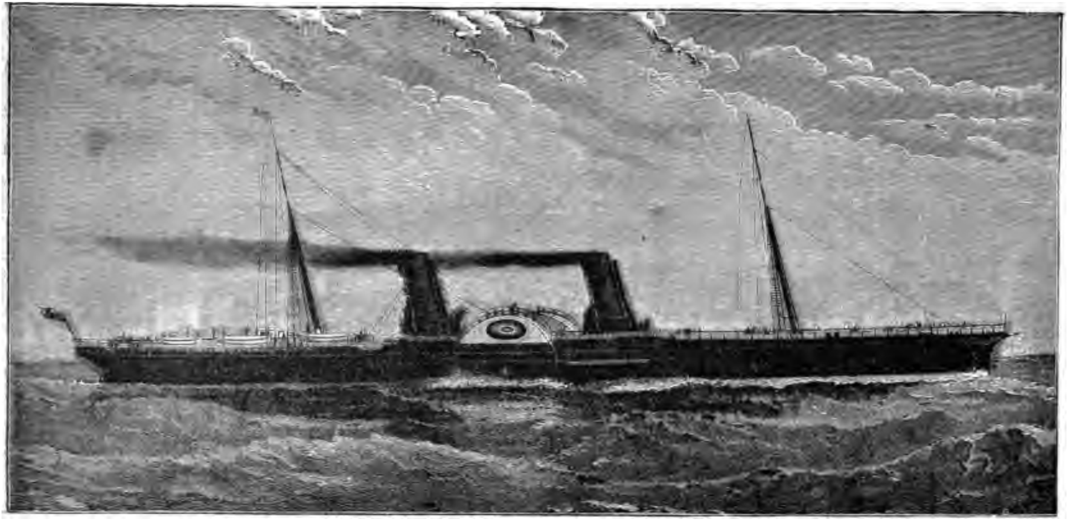
A voyage of a steam collier from Newcastle to London and back occupies from six to eight days. A vessel of this sort can deliver fifty thousand tons of coal in London annually, while the ordinary sailing collier could not deliver under favorable circumstances more than three thousand five hundred tons. The Reading and other coal companies in the United States have a good many steam colliers in use. Few of these boats in Atlantic waters have any accommodations for passengers, but on the Pacific coast, between Puget Sound and San Francisco, they are fitted for the transportation of passengers, and also for general cargoes on their return trips to the mines.

The first steam vessel employed regularly in the Irish trade from Liverpool was the Waterloo, built at Greenock in 1819, and intended to run between Glasgow and Belfast. After a few trips in that service she was placed on the line between Belfast and Liverpool, arriving for the first time in the latter port on the 23d of July of that year. The Liverpool *Mercury* described her as "a beautiful steam packet of 201 tons, 98 feet long, 37 feet wide on deck, and having two highly-finished engines of 30 horse-power each, which work without noise or vibration, and are, on the low-pressure construction, quite safe from accident." The paper adds that "her interior accommodations are as complete and elegant as skill and expense can make them. She has a handsome dining-room, capable of accommodating all the cabin passengers, a separate and neatly decorated cabin for ladies, two apartments for private families, twenty-two well-furnished beds, and a comfortable place for steerage passengers." The fare was £1 11*s.* 6*d.* for the first cabin and 10*s.* for steerage. Passengers were informed that they were not under the necessity of taking provisions, as every thing could be had on board at moderate prices. She was to accomplish the journey in thirty hours, and would sail every Monday and Friday from Liverpool.

Afterwards the Waterloo was placed on the line between Dublin and Liverpool. Compare the description of this steamer with that of one of the latest boats plying across St. George's Channel. The Waterloo may be considered the pioneer of the lines that connect England with Ireland, and have obtained the reputation of including the fastest steamers in the world. The most noted of these lines is that of the Dublin Steam Packet Company, and its most noted vessels are those that carry the mails between Dublin and Holyhead. About twenty-five years ago a service of fast steamers was established on this route. Four vessels—the "Ulster," "Munster," "Leinster," and "Connaught"—made regular trips daily each way regardless of weather, and the contract required them to perform the journey in four hours under a penalty of twenty-five dollars a minute for all time they fell short of that schedule.

Quite recently a new packet, the "Ireland," has been placed on this route, and her owners claim that she is the fastest steamer afloat. The following description of this boat and her performance was published in October, 1885 :

"The Ireland attained a speed of twenty-one knots an hour, or between twenty-four and twenty-five statute miles, in her trial run across the Channel. The distance in a straight line from Holyhead to Kingstown is fifty-six knots; but, however well a ship may be steered, it is impossible for her to keep an absolutely straight course, and the distance actually traversed must have been increased accordingly; yet taking no account of this, and reckoning the distance at fifty-six knots, the ship must have maintained an average speed of 20.2 knots per hour from point to point; a performance which is without a parallel in rough-water steaming. The actual time was 2h. 46 min. 15 sec., with a mean of 6,337 indicated horse power, under draught moderately forced by fans, the mean pressure of steam being 27 lbs., and the engines making 27.17 revolutions a minute. Another trip, under natural draught without fans, gave an average speed of 18.9 knots, the whole time being 2h. 57 min. 45 sec. The Ireland has a length over all of 380 ft., between perpendiculars 360 ft., with 38 ft. beam, and a depth in hold of 19 ft. 3 in., her tonnage being 2,590 tons old measurement. She is fitted with jet condensing oscillating engines, capable of developing 5,000-horse power with boilers working under natural draught, and at least 6,000-horse power with the boilers under air pressure in the stokeholes. The ship is built entirely of Siemens steel, in order that the greatest strength may be secured with the minimum of weight, and is subdivided by steel water-



City of Dublin Steam Packet Company's New Mail Steamer "Ireland."

tight bulkheads to the upper-deck into eleven compartments, one bulkhead between the engine-room and each boiler-room, so that the engines and each set of boilers are in separate compartments.

"The Ireland has a clipper stem with shield head, and a short bowsprit, a light elliptic counter, two raking masts and two funnels, a spacious bridge deck amidships, a long poop aft, and hurricane deck forward. The passenger accommodation is the same as in the Company's present steamers as now fitted, with every comfort and luxury. In the poop is a saloon 80 ft. in length, panelled in polished hard wood, with state cabins at each side. On the deck below is the spacious dining-saloon, richly decorated in gold and color, with a commodious serving-room and pantry. Forward are the upper and lower ladies' saloons, which are elegant apartments. The saloons have a height of 10 ft. 6 in. from deck to ceiling; the stairways are roomy and well arranged, the ventilation and light being all that can be desired; forward is additional sleeping accommodation for first-class, so that in all there will be accommodation for 200 first-class passengers. Handsome and convenient smoking-cabins are provided amidships; a spacious saloon and cabins forward for second-class. The arrangement of pantries, lavatories, and such offices is extensive and complete, and the ship is lighted with the electric light."

The predecessors of the Ireland frequently made the passage at the rate of twenty-two miles an hour, but they seem to be left behind by this latest addition to the fleet. Improvements are being made in the old boats, and new ones will follow and probably pass the Ireland before this book has gone through the press. The time between London and Dublin has been reduced to ten and a half hours and it is possible that by the end of the century it may be brought down to ten or even to nine hours. In his wildest moments Fulton never dreamed that a steamboat would be able to pass through the water at the rate of twenty-four miles an hour!

Admiral Preble says England owes to David Napier the establishment of deep-sea communication by steam packets. When steamboats were established on the Clyde they did not venture out of the rivers and friths except in fine weather; Napier conceived the idea of establishing steam communication on the open sea, and as a first step in this direction he wished to know the difficulty he would have to encounter. With this object he took passage on a sailing packet—then the only means of communication—between Glasgow and Belfast, at a stormy period of the year. The sailing voyage usually occupied a week; the journey by steam is now made in nine hours.

During the voyage Napier used to stand for hours together on the bow of the packet, watching the waves breaking at the stem. He occasionally left his post to ask the captain if the sea might be considered a rough one; when told it was nothing unusual he resumed his studies with an air of disappointment. He did not mind being drenched with the spray, and as the breeze freshened into a gale he again asked if the sea could be called rough. He was again disappointed and resumed his place.

At last he had a storm that satisfied him. The sea broke over the bows and swept the ship from stem to stern; as he made his way aft and stood dripping before the captain he repeated his inquiry: "Do you consider it rough now?"

The captain answered that he did not remember to have faced a worse sea in the whole course of his experience.

"Oh! If that 's all," said Napier, "I think I can manage it"; and with these words he went to his cabin, and did not trouble himself much about the waves after that.

Afterwards he experimented with models of boats in tubs of water, in order to find the shape of bow that would go through the liquid with the least resistance. He had a theory that the round, bluff bow of a sailing vessel was not adapted to a boat with its own power of propulsion, and his experiments confirmed him in his belief. This led him to adopt the fine wedge-shaped entrance for which his boats were distinguished, and which has been generally adopted for steamers all over the world.

Napier established steam communication between Greenock and Belfast in 1818 with the steamer Rob Roy, which has been mentioned elsewhere. She ran for two winters between these ports, and was afterwards placed on the route between Dover and Calais. The Rob Roy was of 90 tons burthen and 30-horse power. In 1819, Napier superintended the building of the Talbot, 150 tons, and 60-horse power, which was placed between Dublin and Holyhead about the time the Waterloo began running between the Irish capital and Liverpool. Napier introduced surface condensers on the steamer Post Boy in 1822. They consisted of small copper pipes, surrounded by cold water, the steam passing through the pipes being condensed while on its way to the air-pump. The experiment was a failure, and he returned to the old system of jet condensation. Some years later he tried flat plates instead of tubes, and was more successful.

In 1826 Napier built what was then considered a leviathan steamer for the trade between London and Edinburgh. She was named the United Kingdom, and her immense size attracted thousands of people to see her.

The measurements of this embryo "Great Eastern" were 160 feet long, 26½ feet beam, and engines of 200-horse power. Some of the wise ones shook their heads, and said she was too large to be profitable to her owners, and they feared her great size would make her unwieldy at sea in rough weather.

Down to 1823, eleven years after Bell's successful experiment with the Comet, one hundred and sixty-seven steam vessels were launched in Great Britain. The largest of these was the Soho, of 510 tons—smaller than the Chancellor Livingston, 520 tons, which was running in New York waters in 1816. A still larger boat, the Lady Sherbrooke, 787 tons, was running on the St. Lawrence at the time the Soho began her career.

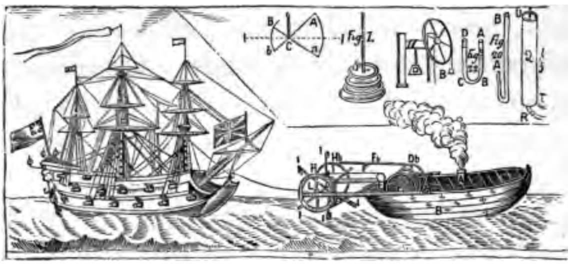
In 1836 France had only eighty-two steamboats, the most of them being small affairs, and only intended for the rivers of the country. Twenty-one were tow-boats, forty for passengers, and seventeen for carrying freight. They averaged a measurement of 180 tons and 35-horse power each. At the same time the French navy contained twenty-seven steam vessels, while fifty-four steamers were in course of preparation for the use of the French Postal Department in carrying mails in the Mediterranean.

In that year, 1836, while France had eighty-two steamboats of all kinds, England possessed three hundred and ninety-seven. One hundred and fifty-three were below fifty tons each in measurement and one hundred and eighteen more were under one hundred tons. The largest was the Monarch, of London, which measured 587 tons, and there were only two or three others that exceeded 500 tons. The newspapers of 1836 spoke of an "immense steam frigate to be called the 'Gorgon,' to be built in London. She is to be eleven hundred tons, and will carry twelve guns."

In 1837, one year later than the above, the United Kingdom had 618 steamers. Of these there were 432 belonging to England, showing an increase of thirty-five in a twelvemonth. From this point we will drop the annual record of steam navigation in England, to avoid pages of figures which might be dreary, and come, at a single bound, to the present time. Observe the rapid growth of the steam interest on the water under the flag of St. George and the Dragon.

The United Kingdom now employs a total of 4,753 steamers; 3,047 of these vessels are engaged in ocean navigation, 137 in what may be called the "long coasting trade," and 1,569 in harbors, rivers, and "short coasting." The aggregate measurement of this enormous fleet is 3,656,000 tons. The total number of registered steam vessels in Great Britain and its colonies—which comprise the British Empire—is 8,206, with an aggregate measurement of 4,013,000 tons. These figures do not include the navy of Great Britain, of which we will speak on another page.

Elsewhere will be found a table showing the number and tonnage of the steam vessels of the principal countries of the globe. It must be understood that, while approximately correct, these figures cannot be so exactly. New vessels are constantly being added to the fleets of the various maritime nations, and at the same time old ones are withdrawn from service, and both new and old ships are lost at sea or upon inland waters.



The Earliest Tow-Boat.

CHAPTER XVI.

First steamboat in India—An eventful career of sixty years—Steamers in Chinese waters—The " Fo-Shune "—The mails to India—Steam navigation in Japan and China—Early steamers on the Atlantic—The log-book of the Savannah—The Sirius, Great Western, and British Queen—Prospectus of the British and American Steam Navigation Company.

FROM Europe we will turn our eyes to Asia. The first steamer in India was the Snake, built in Bombay, in 1820, for the navigation of the Indus River. Her engines were designed and built by a Parsee, after drawings which he had obtained from London ; they were evidently well constructed, if we may judge by the life of the boat. The Snake was employed in the first and second Burmese wars (1824 and 1852), in an expedition to the Persian Gulf in 1826, in the war with Ghina (1841–2), the Persian war of 1856, the Mutiny of 1857, the Chinese expedition of 1859, and several other campaigns of lesser note. She was wrecked twice,—in a hurricane in 1837 and a cyclone in 1854,—but managed to survive all her ills and adventures until 1880, when she was broken up, after an eventful career of sixty years.

In 1821, a steamer of sixteen-horse power, and called the Diana, was sent to China for use on the Canton River, but she was not successful there. In 1823 she was sent to Calcutta, and partially rebuilt; then she was sold to the Bengal Government, and used to navigate the Irrawaddy. She carried the British Resident, Sir James Crawford, five hundred miles up that stream, but as she only succeeded in making about thirty miles a day, she disappointed her owners and soon after disappeared from history.

A sailing ship, the Falcon, was fitted with auxiliary engines, and sent to India in 1820, making part of the voyage under steam. She returned in the same way, but the saving of time was not enough to encourage her owners to continue the experiment. In 1825, the steamship Enterprise, commanded by Lieutenant Johnson, of the Royal Navy, was despatched from London for Calcutta. She was of 470 tons burthen, with engines of 120-horse power. She was built by an association of gentlemen who sold her for forty thousand pounds to the Bengal Government. The purchase money added to what had been received for passengers and freight reimbursed them well for the cost of the boat.

The distance from London to Diamond Harbor, at the mouth of the Hoogly, is 13,700 miles, via the Cape of Good Hope, the only route then available. The Enterprise sailed on the 16th August, 1825, and made the voyage to Diamond Harbor in 113 days; she was at anchor 10 days, under steam 64 days, and under sail 39 days. Lieutenant, or "Captain," Johnson received ten thousand pounds sterling for making the first steam voyage to India; many a modern shipmaster would willingly make it for fifty pounds. The Enterprise was employed to great advantage by the East India Company in the Burmese and other wars. At the time of the treaty of Malwa she saved the government no less than sixty thousand pounds sterling by arriving at Calcutta in season to prevent the march of troops from the northern provinces of Bengal.

The Enterprise may be considered the pioneer of the numerous steam lines that now connect England with India, a few by way of the Cape of Good Hope, but the greater number through the Suez Canal. Five years after her voyage, the British Government sent the steamer Meteor to the Mediterranean in the postal service, and this is said to have been the first use of steam in the transportation of the foreign mails. In March of the same year (1830), the armed steamer, Hugh Lindsay, left Bombay for Suez, carrying the mails from India, and a single passenger, Colonel Campbell, the only one for which she had room. The Hugh Lindsay was of 411 tons, and had two engines of 80-horse power each. On leaving Bombay she was so deeply laden with coal that her deck was almost level with the water, and her wheels could hardly revolve. She could only carry coal enough for six days' steaming, and on reaching Aden, she had less than a hundred bushels remaining. She made the voyage from Bombay to Suez in thirty-three days, having lost twelve days while coaling at Aden, Mocha, Jiddah, and Kosseir. Consequently her time under steam was twenty-one days, making an average of 155 miles a day. When she left Bombay the deck was piled with coal and the cabin filled with it.

The letters sent by the Hugh Lindsay reached England in less time than any previous mail from India, and the success of the trip, in spite of its great cost, led to the opening of the so-called "Overland Mail Route." The only land journey on the line when it was first established was from Alexandria to Suez, a distance of 250 miles; the rest of the route from London to Bombay, 6,126 miles, was upon the sea. It is sad to record that Lieutenant Waghorn, the founder of the overland mail route, spent much time and energy in that work, and died in poverty after its success was assured. Through his exertions was founded the Peninsular and Oriental Steam Navigation Company, popularly called the "P. and O.," and one of the largest steamship companies in the world. It will be mentioned more extensively in a later chapter.

After the experiment with the Diana at Canton nothing seems to have been done in the navigation of Chinese waters by steam for several years. Rev. E. C. Bridgeman, one of the pioneer missionaries from America to China, says in his diary under date of April 19, 1832: "Arrived here (Macao) in the steamer Forbes—the first ship of this kind that has ever visited these shores. She 's a wonder to the Chinese. They call her *Fo-Shune*—'The Fire-ship.'"

The Forbes was sent out in pieces from Boston and put together near Whampoa anchorage, below Canton. In 1835 some of the English merchants attempted to run a small steamer—the Jardine—upon the Canton River, connecting the ports of Lintin, Macao, and Whampoa. The Chinese opposed it so energetically that there was danger of international trouble, and the project was given up. There was a voluminous correspondence between the foreign merchants and the Chinese authorities upon the subject. The governor of Canton ordered the forts to open fire upon the steamer if she attempted to pass up to the city, and he was evidently afraid that the foreigners had some other motive than that of establishing speedy communication from place to place.

The Jardine was sailed out from Scotland as a schooner, carrying her engines carefully packed and stowed in her hold. On her arrival the machinery was put in working order, and she made several trips between Macao and Lintin before the application was sent for the authorization of the Chinese governor. After the war of 1841 a new treaty enabled the foreigners to secure their steamboats against molestation. The Jardine was eighty-five feet long, seventeen feet beam, and drew six feet of water. The power of her engines is not known.

Between 1841 and 1850 several English and American steamboats were sent to China—some going under steam, and others being shipped in pieces that were put together on arrival. Among these vessels was the schooner-rigged screw steamer Midas, Captain Poor, which went from New York to China in 1843, probably the first voyage of that length ever undertaken by a steamer. One of the earlier boats—the Spark—is still running between Canton, Macao, and Hong-Kong, or was doing so at last accounts. She was sent from Boston in pieces somewhere about 1847, and has been rebuilt and lengthened within the last few years. About 1876 she was captured by Chinese pirates, and all the Europeans on board were killed, but the vessel escaped serious injury. Between 1850 and 1870 a considerable number of large steamboats was sent out, generally by way of the Cape of Good Hope, and an excellent service was established on the rivers of China and along the coast.

In 1860 the Yang-tse-Kiang was temporarily opened to foreign trade, and an English steamer went to Hankow, six hundred miles above the mouth of the river, to load a cargo of teas direct for London. At present a good many tea-steamers are loaded at Hankow every year for London direct, and some of them have made the trip from port to port in less than forty days. Not infrequently there is a race between rival ships, and it is vigorously maintained for the whole distance of eleven thousand miles.

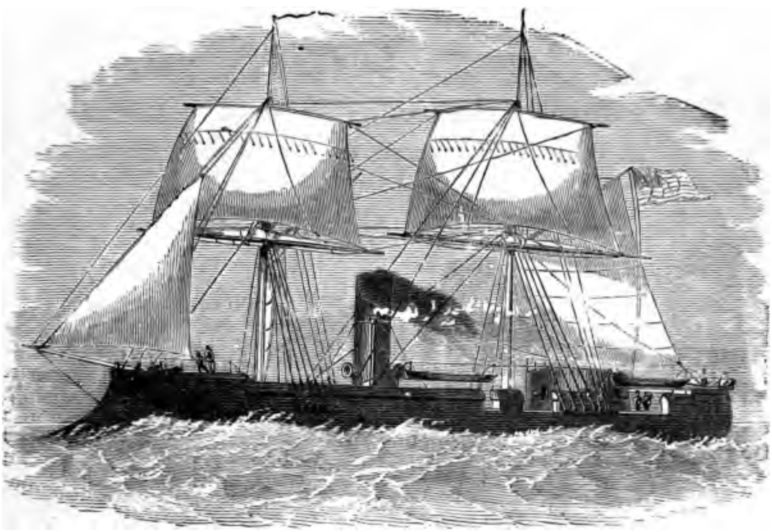
The formal and permanent opening of the Chinese ports to foreign commerce did not take place until the spring of 1861. An American steamer—the Fire Dart—proceeded up the Yang-tse as soon as the treaty was proclaimed. Her owners thought she would be the first on the spot, but on reaching Hankow, she found the Saint Theodosius, a German steamer, quietly anchored in front of the town. In a few days the British steamer Governor-General arrived, and, since then, the navigation of the great river of China has never been interrupted. Three years after this formal opening there was a daily service each way between Shanghai and Hankow, performed alternately by the boats of an English and an American company. In 1877 an American naval vessel—the Monocacy—steamed up the Yang-tse to Ichang, four hundred miles above Hankow and one thousand from the sea. She carried Mr. I. F. Shepard, American consul at Hankow, who formally opened the river to American commerce as far as Ichang.

In 1858 Lord Elgin presented the steam yacht Emperor to the Chinese authorities after they had signed the treaty of Tien-Tsin. This was the first steamer owned by Chinese, but since that time they have bought foreign-built steamers in great numbers, and have also learned to build for themselves.

In 1874 some Chinese capitalists organized a steamship enterprise, which they called the "China Merchants' Steam Navigation Company." They bought several steamers belonging to an American firm in China, and started a line between Shanghai and Hankow. An English company had a line on the river, and a fierce competition began between the two concerns. The rates of freight and passage fell to a ruinous figure; the Chinese company obtained most of the business, and, finally, the foreigners were obliged to sell out their twenty-six boats and their wharf property to the Orientals.

Before the sale of the river line, the Chinese had established coast lines to Foo-Chow, Hong-Kong, Tien-Tsin, and other places, and they have several other lines in operation in the Eastern seas. During the difficulties with the French in recent times, the steamship enterprises of the Chinese were considerably restricted; some of their boats passed into the hands of Americans, but it was clearly understood that the transfer was only temporary. China possesses enormous coal fields and iron mines, and it is quite possible that she may yet become one of the leading nations in navigating the ocean by steam-power.

The Japanese Government bought several steamships in 1859–1860. In 1861, two steamers were

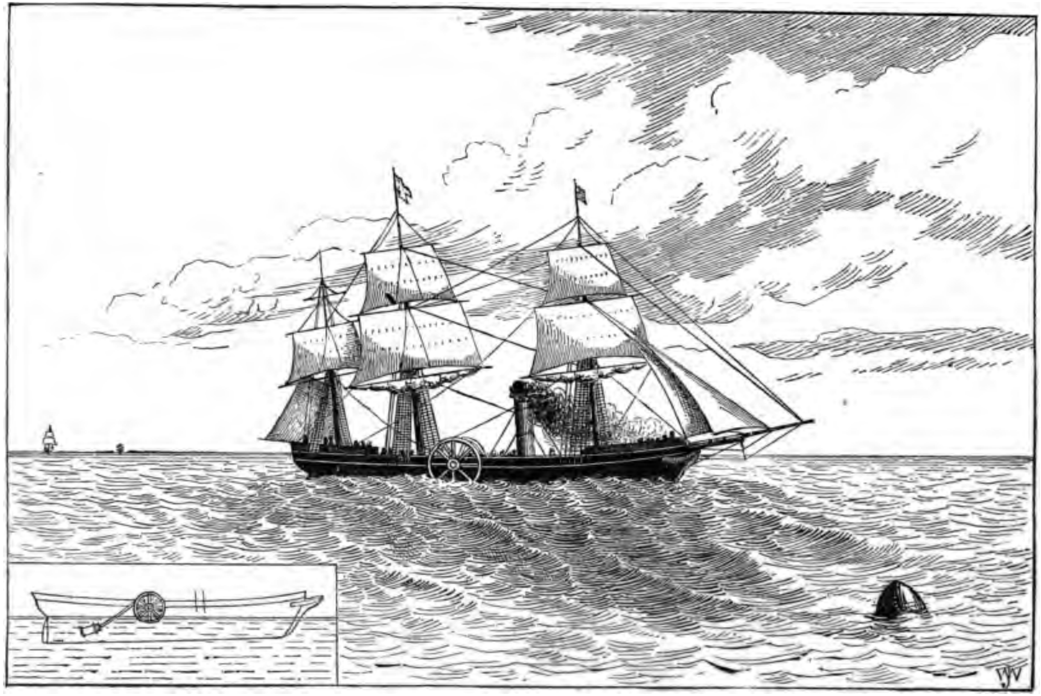


The "Stonewall."

purchased by the Prince of Satsuma, and were the first vessels of the kind owned by Japanese, except by the government. Considering their former seclusion from the rest of the world, this Oriental people have made remarkable progress in steam navigation. They have steamship lines of their own; they have ship-yards, where they build and equip steamers on the European model; and they have foundries where first-class marine engines are turned out. Japanese men-of-war, wholly built, armed, equipped, and manned by Japanese, have appeared in foreign waters, and demonstrated the ability of the people of Nippon to adopt the ways of the Occidentals. One of the first iron-clads owned by the Japanese Government was the Rebel ram, Stonewall, which was surrendered to the United States by Spain at the close of the Civil War. She was of twelve hundred tons burthen, and carried three guns.

The first steamer to Australia has been mentioned elsewhere, and so has the first steamer to pass the Straits of Magellan. We will now turn to a subject of special interest—the inauguration of steam navigation upon the Atlantic.

The Atlantic Ocean was first crossed by a steamer in 1819, and the feat was performed by an American vessel, the Savannah. English writers have patriotically attempted to falsify history regarding this pioneer of transatlantic navigation. Woodcroft, in his work on steam navigation, pronounces the Savannah a myth; the *Illustrated London News*, as late as 1858, says: "It is forced into the belief that she was merely an after-thought of the Americans"; and the writer of the article upon steam navigation in "Chambers's



The Savannah.

Encyclopedia" (American edition, vol. ix., page 108) ignores the Savannah completely, and says the first transatlantic voyage was made by the Sirius in 1838.

The Savannah was of three hundred and eighty tons burthen; built at New York, to run between that port and Liverpool as a sailing packet. She was launched August 22, 1818. About the time she came from the ways she was bought by several gentlemen of Savannah, at the suggestion of Captain Moses Rogers of that port, and fitted up as a steamer.

No change was made in her rigging, as it was intended that she should make use of her sails when ever she could do so. She was fitted with engines and the proper machinery for working a pair of paddle-wheels, which were so constructed that they could be shipped or unshipped at pleasure. The wheels folded up like a fan, and were easily brought in upon the deck when not in use, and the shaft had a joint to facilitate the operation.

The Savannah made a trial trip from New York to Savannah and back again in April, 1819, going part of the time under steam and the rest under sail. In May she left New York for Savannah under sail only; from Savannah she went to Charleston, S. C., and invited the President of the United States to go in her to Savannah, but the President declined. However, he was shortly afterwards in the latter city, and made an excursion on the steamer, accompanied by his staff and several officers of the army and navy. He told Mr. Scarborough, one of her owners, to bring her to Washington on her return from Liverpool, as he thought the government would purchase her for use as a cruiser in the Caribbean Sea.

On the 26th of May, 1819, she sailed from Savannah for Liverpool. She was commanded by Captain Moses Rogers and navigated by Stephen Rogers, both natives of New London, Connecticut, and carried seventy-five tons of coal and twenty-five cords of wood. The passage from Savannah to Liverpool was made in twenty-six days, eight under sail and eighteen under steam. An article in *Harper's Magazine* for February, 1877, says Captain Moses Rogers "commanded the first steamboat on the Hudson, the first steamboat on the Delaware, the first steamboat on the Chesapeake, the first steamboat between Charleston and Savannah, and the first steamship that crossed the Atlantic." On his return from Europe he was engaged in navigating the Great Pedee River in South Carolina, and died of malarial fever at the early age of forty-two years. Stephen Rogers, the sailing-master of the Savannah, died at New London, Connecticut, in 1868, at the age of seventy-four years.

Any British reader who has doubts concerning the performance of the Savannah is referred to the following:

The log-book of the Savannah, which is still in existence and in the possession of the descendants of Captain Rogers.

The London *Times* of May 11, 1819, which contains the following paragraph:

"GREAT EXPERIMENT.—A new steam vessel of 300 tons has been built at New York for the express purpose of carrying passengers across the Atlantic. She is to come to Liverpool direct."

The New York *Register* of August 21, 1819, which contains the following:

"The steamship Savannah, Captain Moses Rogers, the first that ever crossed the Atlantic, arrived at Liverpool in twenty-five days from Savannah, all well, to the great astonishment of the people of the place. She worked her engines eighteen days."

The sworn statement of Stephen Rogers, the sailing-master of the Savannah, made at New London, Connecticut, May 2, 1856.

Paragraphs in the London *Times*, June 21 and 30, 1819, and *Loyd's List*, June 20, 1819.

Several paragraphs in other London and Liverpool papers of the months of June and July, 1819. Also paragraphs in English and American papers recording the movements of the vessel in her further voyage to Copenhagen, Stockholm, and St. Petersburg.

The log-book of the Savannah contains ninety-six pages of coarse paper, nineteen and one half inches long and twelve inches wide. The book is not bound, but the sheets are stitched together and sewn into a cover of sail-cloth, which is bound at its upper and lower edges. The cover bears the words " Steamship Savannah's Log-Book " in large, square letters. Fifty pages are written upon and the remainder are blank. The handwriting is that of Stephen Rogers, sailing-master, and, though somewhat dimmed by age, the ink is still black and the entire journal is legible. The first page has the caption :

" A journal of a voyage from New York towards Savannah on board steamship *Savannah ;* Moses Rogers, Master."

The caption is the same on the second, third, and fourth pages. On the fifth page it changes to " A harbour journal on board steamship Savannah ; Moses Rogers, Master." A few pages further on it changes again, and reads : " A journal of a voyage from Savannah towards Liverpool on board steamship Savannah ; Moses Rogers, Master."

Judging by the log-book of the Savannah, Stephen Rogers was better versed in the teachings of Bowditch's Navigator than in those of Murray's Grammar or Webster's Spelling-Book. The first entry in the log is as follows :

"Sunday March 28th 1819. These 24 hours begins with fresh breezes at N. W. At 10 A.M. got under way for Sea with the crew on board. At 1 P.M. the pilot left the Ship at Sandy hook light."

The second entry reads:

"Remarks on board Monday March 29th 1819. These 24 hours begins with fresh breezes and clear. At 4 P.M. the Hilands of Neversink bore N. b. W. 6 leagues distant from which I take my departure. At 10 P.M. took in Topgallant Sails. At 6 A.M. Set Topgallant Sails. At 8 A.M. Tacked Ship to the Westward. Saw a brig and Schooner Steering to the Westward. At 11 A.M. took in the Mizon and Fore Top gallant Sails. At 11 A.M. got the steam up and it come on to blow fresh we took the Wheels in on deck in 30 minute. At meridian fresh breezes and Cloudy. Lat. by Obs. 39° 19'."

On the Saturday following the departure from New York the book says: "These 24 hours begins calm and pleasant. Used Wheels middle of the Day."

The sailing-master was not inclined to rhetorical phrases, as the book is singularly laconic in style. An entry on May 12th says: "Daniel Claypit cut his left thum off, the Doctor done it up and then bled James Monroe." On May 19th it tells us that "John Western comeing on board from the shore fell of the Plank and was Drounded. He was a native of Massachusetts, Town of Gray. At 10 A.M. cought John Western with a boat-hook and jury was held over him braught in accerdental Deth took him on board the Ship and put him in a Coffin."

The departure on May 22d for the first transatlantic steam voyage is recorded in the brief words, "Got steam up and at 9 A.M. started." The daily records from this time on usually open with the words, "These 24 hours begins with," etc. On the 22d June they "stopped the Wheels to clean the clinkers out of the furnice, a hevy head sea, at 6 P.M. started Wheels again; at 2 A.M. took in the Wheels."

The coast of Ireland was sighted on the 17th of June, and on the 17th the Savannah "was boarded by the King's Cutter *Kite*, Lieutenant John Bowie." In a subsequent letter to the New London *Gazette* Stephen Rogers says: "She [the steamer] was seen from the telegraph station at Cape Clear, on the southern coast of Ireland, and reported as a ship on fire. The admiral, who lay in the Cove of Cork, despatched one of the king's cutters to her relief. But great was their wonder at their inability, with all sail on a fast vessel, to come up with a ship under bare poles. After several shots were fired from the cutter the engine was stopped, and the surprise of her crew at the mistake they had made, as well as their curiosity to see the singular Yankee craft, can be easily imagined. They asked permission to go on board, and were much gratified by the inspection of this naval novelty."

Two days later they "shipped the wheels and furled the sails and run into the River Murcer, and at 6 P.M. come to anchor off Liverpool with the small bower anchor."

The steamer caused a great deal of excitement not only among the sailors and ship-owners, but the entire population of Liverpool. She was compelled to wait at the bar several hours for the turn of the tide, and the news of her coming was spread through the streets. As she came to anchor the shipping, wharves, and roofs of houses were crowded with people anxious to see the steamship from America. During her stay in Liverpool the Savannah was visited by great crowds, and among them were merchants and naval officers who made many inquiries about her speed, destination, and other particulars. She left on the 23d of July, "getting under way with Steam, and a large fleet of Vessels in company." Touching at Copenhagen and Stockholm on her way to St. Petersburg, the Savannah attracted much attention. At Stockholm she was visited by the king, and also by "the American Minister and Lady and all the Furran Minersters and their Ladyes."

At St. Petersburg she was visited by the Lord High Admiral of the Russian navy and by other distinguished officials, with whom she made an excursion to Cronstadt. She sailed from St. Petersburg on her return to Savannah on the 10th of October and reached her destination November 30th.

After her return it was not deemed advisable to continue her as a steamship; her engines and boiler were removed and sold to the proprietors of the Allaire Works, of New York, for $1,600. The engine was used for other purposes for a good many years, and at the time of the World's Fair in New York (1856) the original cylinder of the Savannah was on exhibition, and with it the log-book of the ship. Before the removal of the engines the Savannah was sent to Washington, as appears from the log, but the government did not buy her. She afterwards ran as a sailing packet between New York and Savannah, and was ultimately lost on the south side of Long Island, where so many ships have laid their bones to rest.

Among the souvenirs of the voyage retained by the descendants of the captain and sailing-master are a gold snuff-box, presented to the latter by the Emperor of Russia, and a massive gold-lined tea-kettle, whose story is told by the following inscription:

"Presented to Captain Moses Rogers, of the steamship Savannah (being the first steam vessel that had crossed the Atlantic), by Sir Thomas Graham, Lord Lynedock, a passenger from Stockholm to St. Petersburg, September 15, 1819."

There is a popular tradition that on the day the steamship Savannah entered the harbor of Liverpool, a pamphlet was published by Dr. Lardner in which that gentleman demonstrated the impossibility of crossing the Atlantic with a steamship. The London *Nautical Magazine* for March, 1837, uses the following words:

"The time is fast approaching when the famous prophecy of the Rev. Dr. Dionysus Lardner, delivered in Dublin and re-delivered in Bristol, 'that it is as easy to go to the moon as to go direct from a port in England to New York,' will be tested." Then follows an account of the efforts that the rival companies, the Great Western and the British and North American, were making to establish steam navigation across the Atlantic.

In the "Museum of Sciences and Arts," vol. x. (1856), Dr. Lardner emphatically denied the use of the language imputed to him. "What I did affirm in 1836–37," said he, "was that the long sea voyages by steam which were contemplated could not at that time be maintained with the regularity and certainty which are indispensable to commercial success, by any revenue which could be expected from the traffic alone, and that without a government subsidy of a considerable amount such lines of steamers, although they might be started, could not be permanently maintained."

Dr. Lardner was born in 1793, and, consequently, was but twenty-six years old at the time of the Savannah's voyage. He had graduated from Trinity College, Dublin, two years before, and was still a resident member of the university, devoting his attention to mathematics. In 1828 he published " Popular Lectures on the Steam-Engine," for which the Royal Society of Dublin gave him a gold medal. In this volume he used the following words :

" Among the various ways in which the steam-engine has ministered to the social progress of our race, none is more important and interesting than the aid it has afforded to navigation. Before it lent its giant powers to that art, locomotion over the deep was attended with a degree of danger and uncertainty, which seemed so necessary and so inevitable, that, as a common proverb, it became the type and representative of every thing else which was precarious and perilous. The application, however, of steam to navigation, has rescued the mariner from much of the peril of the winds and waves ; and even in its actual state, apart from the improvements it is still likely to receive, it has rendered all voyages of moderate length as safe and regular as journeys over land.

" We are even now upon the brink of such improvements as will probably so extend the powers of the steam-engine as to render it available as the means of connecting the most distant points of the earth," When we remember that this was written before any ship propelled entirely by steam had crossed the Atlantic, we should commend Dr. Lardner for his prophetic vision, rather than censure him for words which he declares most positively never to have uttered.

In 1827 a company of merchants of Amsterdam and Rotterdam united for the purpose of establishing a steam line to the West Indies. They ordered from a Scotch builder on the Clyde a steamer of three hundred and fifty tons burthen and one hundred horse-power, which they called the Curaçoa. She was despatched from Amsterdam in the summer of 1829 (another account says from Antwerp in August, 1828) for Curaçoa in the Dutch West Indies. She made several voyages, but the enterprise was not commercially successful, and was abandoned in 1830 or '31. This was the second steamer to make the transatlantic voyage.

The third steamship to cross the Atlantic was the Royal William, built at Quebec for the Quebec and Halifax Steam Navigation Company. She was towed to Montreal and fitted with side-lever marine engines built by Bennett & Henderson, and soon after they were ready, she returned under steam to Quebec and started on her voyage. While steaming through the Gulf of St. Lawrence, she was fired upon by one of the British frigates, and was compelled to lie to until she could be examined to show there was nothing diabolical about her. She carried a few passengers, but no cargo, as all her storage room was required for coal. She reached the Thames in safety, and was there sold to the Spanish Government. She was re-christened Isabella Second, and became the first war steamer of the Spanish navy.

His Britannic Majesty's steamer Rhodamanthus is said to have reached Barbadoes May 17, 1832, from Portsmouth, England. Previous to her departure the Portsmouth *Herald* said: "We are anxious to learn what may be the effect of the climate on the engines, fittings, etc."

The above statement is from Admiral Preble's record, and would indicate that the Rhodamanthus was the fourth steam vessel to cross the Atlantic. But as she was a war vessel, and not a commercial steamer, we will leave her out of consideration, and regard the British steamer Sirius as entitled to the fourth place on the list. The Sirius sailed from Cork April 4, 1838, and arrived at New York on the morning of April 23d.

The steamship Great Western sailed from Bristol four days later than the Sirius, and reached New York in the afternoon of the 23d of April, thus making herself the fifth on the list. The Sirius was of 700 tons and 250-horse power, and the Great Western of 1,340 tons and 450-horse power. The latter was built expressly for the transatlantic service, while the Sirius was chartered by a company then engaged in building the British Queen, which was intended to be the most wonderful craft afloat.

The company which sent out the Sirius was organized by Dr. Junius Smith, an American, who graduated at Yale College in 1802, and spent the most of his life in London. Crossing the Atlantic in 1832, he was fifty-four days from London to New York, and thirty-two from New York to Plymouth on his return. Writing to a friend in New York under date of London, June 28, 1833, he says:

"Thirty-two days from New York to Plymouth is no trifle. Any ordinary sea-going steamer would have run it, with the weather we had, in fifteen days, with ease. I shall not relinquish the project unless I find it absolutely impracticable."

He introduced the subject to the merchants and bankers of London, but did not receive much encouragement. Most of those to whom he talked scouted the idea as visionary, and he further had the opposition of all who were interested in sailing ships, of every name and kind. He was ridiculed as a dreamer, and more than one respectable man of wealth suggested that his proper place was a lunatic asylum. It was the story of Fulton over again, and the story of many an inventor in England and America.

Dr. Smith issued a prospectus proposing a capital of one hundred thousand pounds sterling for building ships of one thousand tons each. No one was inclined to invest, and then he issued a second, and afterwards a third prospectus, calling for more money, and proposing larger ships. The third prospectus called for a million pounds, and proposed ships of two thousand tons. He accompanied his proposal by a careful calculation based upon known facts in the commerce of the two countries that were to be united by the new mode of navigating the ocean.

As a last resort, he borrowed the use of the names of influential gentlemen to serve as directors, a plan not unknown at the present time, and in this way floated his company into existence. In July, 1836, he opened the subscription books of the company. The stock was subscribed, and as soon as enough had been allotted for building a steamer, the contract was made for the first vessel. Curling & Young, of Blackwall, were the contractors, and the ship is thus described in a letter from Dr. Smith to a New York correspondent:

"I have the pleasure to inform you that the directors of the 'British and American Steam Navigation Company' have contracted for the building of the largest, and intended to be the most splendid, steamship ever built, expressly for the New York and London trade. She will measure one thousand seven hundred tons, two hundred feet keel, forty feet beam, three decks, and every thing in proportion. She will carry two engines, of 225-horse power each, 76-inch cylinder, and nine-feet stroke. The expense of this steam frigate is estimated at £60,000. These large undertakings require time to mature, but I think the business will at last be done effectually."

The contract for the engines was taken by a Glasgow firm, Claude, Girdwood, & Co., that failed when the work was about two thirds com-completed. A new contract was made with Robert Napier, of Glasgow, and the plans were changed, so as to make the steamer of 2,400 tons. The failure and bankruptcy of the engine-makers and the changes in the plans for the ship caused a year's delay. The Great Western Steamship Company, a rival concern, had arisen and built the steamer Great Western, and for fear of losing the prestige of being the first to cross the Atlantic, the British and North American Company chartered the Sirius and sent her on the voyage already mentioned before their own steamer was ready for the water.

The new steamer was the British Queen. She started on her first voyage in July, 1839, and made the passage from London to New York in fourteen and a half days, without accident or detention. Both the Great Western and the British Queen were followed by other steamers of their respective companies, and thus was fairly inaugurated the "steam bridge over the Atlantic."

We will close this chapter with the final prospectus of the British and American Steam Navigation Company, issued during the summer of 1838. Considered in its relations to the immense business of transatlantic navigation, the paper possesses much interest.

"BRITISH AND AMERICAN STEAM NAVIGATION COMPANY.

"Capital, £1,000,000, in 10,000 Shares of £100 Each.

"DIRECTORS:

"Henry Bainbridge, Esq., Chairman.

"Chas. Enderby, Esq.	Col. Aspinwall, U. S. Consul.
"Capt. Thomas Larkins.	Junius Smith, Esq.
"Capt. Robert Locke.	Jos. Robinson Pim, Esq., [Liverpool.
"Capt. Robt. Isaacke.	Jas. Beale, Esq., Cork.

"Paul Twigg, Esq., Dublin.

"Bankers—Messrs. Puget, Bainbridge & Co., 12 St. Paul's Churchyard.

"Secretary—Macgregor Laird, Esq.

"The object of this company is to establish a regular and certain communication by steamship between Great Britain and the United States. The vessels are intended to depart alternately from London and Liverpool to New York; their average passage will not exceed fifteen days. The company's first vessel, the British Queen, has capacity for five hundred passengers, twenty-five days' fuel, and eighty tons measurement goods, exclusive of provisions, stores, etc.

"The successful voyages of 'Sirius' and 'Great Western' steamships having placed the success of the undertaking beyond a doubt, the directors are now preparing contracts for other vessels of similar description to the 'British Queen,' and will be able in 1839 to despatch their vessels for New York on the 1st and 16th of each month from London and Liverpool alternately.

"Applications for shares may be made to Macgregor Laird, Esq., at the company's office, 78 Cornhill; to Buxendale, Tathem, Upton, and Johnston, 7 Great Manchester Street, London; to Isaac Miller, Esq., Liverpool; and to Boyle, Low, Pain, & Co., Duane Street, Dublin."*

CHAPTER XVII.

How the Great Western Steamship Company was organized—Samuel Cunard and his enterprises—The Cunard Company—Cutting out the Britannia—Iron taking the place of wood for ship-building—Adoption of the screw—Growth of steamers—Umbria and Etruria compared with Britannia—Steamers never heard from—American steamship lines.

THE Sirius made two voyages to America and was then hauled off and put into other employment. The Great Western ran regularly between Bristol and New York for eight years, when she was sold to the West India Royal Mail Steam-Packet Company, and continued in its service until 1856. She was broken up in 1857 at Vauxhall, as she could not then compete favorably with the new class of steamships.

The Great Western Steamship Company, of which the initial ship bore the name, is said to have been organized at the suggestion of Mr. Brunel, the famous engineer who built the tunnel under the Thames. At a meeting of the directors of the Great Western Railway Company, one of those officials spoke of the great length of the proposed line from London to Bristol. Brunel remarked: "Why not make it longer, and have a steamboat to go from Bristol to New York and call it the Great Western?"

Brunel's suggestion was at first regarded as a joke, but after reflection some of the directors took it in sober earnest. The idea grew as they pondered on it; the British and American Steamship Company was getting into shape and it was thought a good scheme to enter the same field. A committee was appointed to visit the great shipbuilding ports in the kingdom and collect information. In the report of this committee Mr. Brunel suggested that the larger the steamer the greater would be its carrying capacity in proportion to the expense of running her. According to his figures a vessel twice the size of another would encounter four times the resistance at a given speed but would have eight times the carrying capacity. On this principle the "Great Western" was built, and the same idea was carried out in the construction of the British Queen belonging to the rival company.

The Great Western was launched July 19, 1837. The following are her dimensions, which the non-nautical reader may skip:

"Length between perpendiculars, 212 feet; length of keel on the blocks, 205 feet; length of saloon, 75 feet; length over all, from figure-head to taffrail, 235 feet; breadth between paddle-wheels, 34 feet 4 inches; depth under deck to the top of floors, 23 feet 3 inches; scantling floors on side of keel, 15 inches, sided; ditto, moulded, 16 inches; length of floors, 24 feet; thickness of bends, 7 inches; bottom plank, 5 inches; diagonal riders, 5 inches, 3 feet apart; sheer streaks, 5 inches; upper-deck clamps, 8 inches; iron diagonals, 4 inches by $\frac{3}{4}$; bilge planks, 6 inches; keelson, 20 by 21 inches.

"Tonnage, 1,320 tons; best berths, 150; berths for crew, 26; berths for engineers, firemen, and officers, 40; two engines, by Maudsley & Field, 400-horse power, 200 each; diameter of cylinder 73½ inches; length of stroke, 7 feet; coal stowage, 600 tons, or enough for thirty tons per day for twenty days.

"Her whole cost amounted to about £50,000; £21,373 15*s.* 10*d.* was expended for ship-building, £13,500 for engines, about £1,000 for furniture, painting, bedding, and fittings generally for the grand saloon, and the remainder for rigging, equipment, coal, and stores."

The foregoing description is from the New York *Express* of April 24, 1838. The same paper says:

"The 'Sirus' is a beautiful model, 700 tons, 320-horse power, schooner-rigged. Notwithstanding rough weather she came over with perfect safety. Passengers were delighted with her performance. Her boilers were supplied with fresh water by a distilling apparatus which converted the salt into fresh water. The distilling worms (small copper tubes) measured, as reported, nearly four miles!"

The two companies that established transatlantic navigation were not to have the field to themselves. A Liverpool merchant, Sir John Tobin, built a steamer called the Liverpool, and despatched her for New York on October 20, 1838. She put back to Cork on the 26th of the same month, and sailed again on the 6th of November. She made the voyage in sixteen and a half days, reaching New York November 23d. The Liverpool was originally of 1,150 tons, but she was afterwards increased to 1,543 tons. She made six voyages to New York and back, and was then transferred to the Peninsular and Oriental Company, in whose service she was wrecked in 1846 off Cape Finisterre. After her increase in length and tonnage she was called the Great Liverpool. Her speed was never equal to that of the Great Western, which once made the voyage from New York to Liverpool in twelve and a half days.

The earliest of the transatlantic lines now in existence was also one of the earliest that was formed at all. Samuel Cunard, a merchant of Halifax, had a line of sailing packets between that port and England; they were not famous for speed, and the enterprising Cunard thought and dreamed of replacing them by steamers. In 1838 he went to England with the view of carrying out his plans, and obtained an introduction to David Napier, the celebrated marine engineer. Cunard gave an order for the building of four steamers of 800 tons each; Napier recommended larger ships, and it was finally agreed to make them of about 1,200 tons burthen and 440-horse power. But this required more money than Cunard could command at the time, and he decided to form a company.

There had formerly been two rival lines of coasting steamers between Liverpool and Glasgow, one owned by the Messrs. MacIver of Liverpool, and the other by Messrs. Burns of Glasgow. After years of keen competition these firms were amalgamated, and the combined concern was very prosperous when Cunard appeared with his proposal to form a steamship company for navigating the Atlantic. Burns & MacIver "caught on" at once, and in 1839 the "British and North American Royal Mail Steam-Packet Company" was formed. The time of an ordinary citizen is too brief for the frequent pronunciation of the foregoing title in full, so custom has abbreviated it to "Cunard Line," by which it is universally known. Samuel Cunard may be considered the father of the line which bears his name and has been in steady operation since 1840.

About the time of the formation of the company the British Government advertised for tenders for carrying the mails by steam from England to Halifax. The Cunard Company obtained the contract for a fortnightly service each way between Liverpool and Halifax, Boston, and Quebec; the contract was to run for seven years, at £60,000 a year. The original plan had been to run between Liverpool and Halifax, and send a branch steamer to Boston, but in making the contract the plans were changed, and the latter city was made the western terminus of the line. The keels of the four steamers then on the stocks were broken up, and new steamers of larger size were put into construction. The first four ships of the Cunard line were the Britannia, Acadia, Caledonia, and Columbia. The Britannia sailed from Liverpool July 4, 1840, and reached Boston on the 18th of the same month, fourteen days and eight hours between the two ports.

The Britannia was not, however, the pioneer ship of the Cunard Company in its transatlantic enterprise. The chartered steamer Unicorn was sent from Liverpool May 15, 1840, with orders to visit Halifax and proceed to Boston. She had twenty-seven cabin passengers for the former place and twenty-four for the latter, and brought Paris papers of the 13th of May, of London the 15th, and of Liverpool the 16th.

Boston went wild on the 2d of June over the arrival of the Unicorn, and she repeated the performance on the day the Britannia came in sight of Long Wharf and the crowds that covered it. Mr. Cunard was a passenger by the Britannia, and received eighteen hundred invitations to dinner within twenty-four hours after he arrived! The cannon of the forts and of the war-ships in the harbor thundered a welcome, there was a notable gathering in Fanueil Hall, fireworks were let off in the evening, and the entire city was in a blaze of glory.

The Acadia arrived on the 17th of August, twelve days and eighteen hours from Liverpool. Three days after her arrival the event was celebrated by a public banquet at which Hon. Josiah Quincy presided. Before the end of 1840 all four ships were running regularly between Boston and Liverpool, touching at Halifax each way, and for seven years the terms of the contract were performed to the satisfaction of the British Government.

There was not the best of feeling between Boston and New York in regard to the transatlantic service, envious inhabitants of the latter village having predicted that the harbor of Boston would freeze in winter and imprison such of the Cunarders as might be there at the time. Three years passed without any accident of this kind, but in February, 1844, the Ice King made his appearance, and the whole harbor was frozen over. The people had a good time on the ice; skaters and sleighing parties were out in large numbers; booths were established for the sale of refreshments of solid and liquid nature, and the scene was a pleasing one to the multitude. But the agent of the Cunard Line was in dismay, as the Britannia was at her dock and her sailing day was approaching. Unless she could get out at the appointed time the contract would be broken and serious consequences might follow.

The pride of Boston was roused as the prophecy of New York seemed about to be verified, and the enterprising merchants in sight of Bunker Hill Monument determined that something must be done. They met one day and resolved to cut a channel for the steamer. The contract for the job was taken by an ice-cutting firm of Boston, who agreed to open the way for the steamer for ten thousand dollars. A channel one hundred feet wide and nearly nine miles long was made through the ice, and at her appointed day and hour the Britannia steamed away on her regular voyage. The job was completed only one hour before the sailing-time of the ship. Since that time ice-boats have been employed to prevent the possibility of another mail-steamer being in a similar predicament. Whenever there is any likelihood that the harbor will be frozen, ice-boats and the numerous tugs belonging to the port are set in motion, and the ice is broken up.

At the expiration of the first contract for a fortnightly service each way a new contract was made. The service was increased to a weekly one and New York and Boston were made the ports of departure on alternate Wednesdays. The amount of the subsidy was greatly increased and the company was required to build larger and faster steamers.

The four steamers with which the Cunard Company began its service in 1840 were of about 1,200 tons burthen and 500-horse power each. As additions were made to the fleet the size and power of the steamers were increased, and this has been the case with nearly every addition to the line. The fifth steamer was the Hibernia, 1,400 tons, 550-horse power; then followed the Cambria of the same measurement; then the America, Canada, Niagara, and Europa, each 1,800 tons and 700-horse power; and then the Asia and Africa, each 2,250 tons and 800-horse power. All these were paddle steamers; the six largest of them varied in length from 275 to 300 feet, and their beams were from 40 to 42 feet. The paddle-wheels were from 32 to 36 feet in diameter; the cylinders were 90 inches in diameter, and the length of stroke was from 8 to 9 feet.

Down to 1852 the Cunard fleet consisted entirely of wooden paddle-ships, but in that year the iron ships Andes and Alps were added. They had screw engines instead of paddles, and were followed by the Jura and Etna, both iron screws.

We will leave for a time the Cunard Company and trace the history of the iron screw steamship. The screw was tried by many persons in the early days of steam navigation, and one experiment at least—that of John Fitch in the Collect Pond, New York—belongs to the last century. The credit of the successful application of the screw to marine propulsion and its consequent adoption belongs to Captain John Ericsson and to the year 1836, though it did not come into general favor for more than a decade after that time.

Captain Ericsson's patent was granted in England July 13, 1836. The captain experimented with a model boat in a bath tub, the engine being supplied with steam by a flexible pipe leading from a steam-boiler over the centre of the tub. The boat moved in a circular direction, in accordance with the "set" of the rudder, at the rate of three miles an hour.

His next trial was with a boat 45 feet long, 8 feet beam, and 3 feet draft, and named the "Francis B. Ogden," in honor of the American consul to Liverpool, who had encouraged his efforts in devising this new mode of propulsion. It had two propellers, each five feet in diameter, and attained a speed of ten miles an hour upon the Thames, in April, 1837. Afterwards she towed schooners of 140 tons seven miles an hour, and a ship of 650 tons five miles an hour. The invention was laid before the British Admiralty and rejected as impracticable, all the naval engineers pronouncing against it.

Capt. R. F. Stockton, of the U. S. Navy, was then in England, and on seeing the boat of Ericsson and making a trial trip with it, was convinced of its practicability. "I do not want," said he, "the opinions of scientific men; what I have seen this day satisfies me." He ordered on his own account two iron boats with screws for the navigation of the

Delaware, and immediately brought the matter before his government.

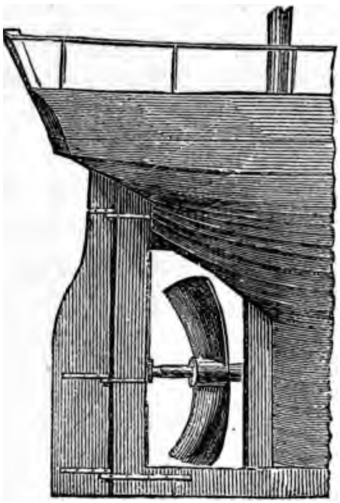
The first of the two boats was named the Robert F. Stockton, and was about 70 feet long, with 10 feet beam. She came to the United States, under sail, in April, 1839; a special act of Congress was passed to allow her to run in American waters, and her name was changed to New Jersey. She may be regarded as the first screw steamer ever practically used in the United States, though not the first that had been tried. She remained in service several years and was the only steamboat capable of towing through drift ice.

Captain Stockton's influence was sufficient to induce the United State Government to try the experiment of the screw for propelling ships of war, and in 1843 orders were given for the construction of the Princeton, the first screw-propelled war steamer the world ever saw. Ericsson designed the engines and machinery so that every thing was below the water-line and out of the reach of shot, and the furnaces were made for anthracite instead of bituminous coal. The funnels were telescopic, and consequently the ship could have all the appearance of a sailing vessel when the engines were not in use.

The Princeton was a second-rate sloop-of-war, 164 feet long and 30 feet beam. She carried two 225-pound wrought-iron guns and twelve 42-pound carronades, and was considered in her day a most efficient ship. Shortly after going into commission she raced with the steamship Great Western as the latter was leaving for a transatlantic trip. She easily passed the Great Western, steamed around her, and passed her again before the latter was willing to acknowledge defeat. The captain of the Great Western was aware of the intended trial of speed, and exerted his ship to her fullest power, but to no purpose.

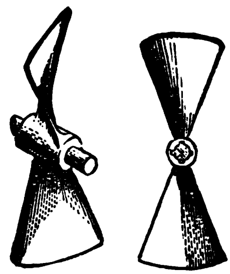
Not long after the successful trial of the Princeton, the English and French governments roused themselves to the advantages which the new style of ship possessed. The English Government brought out the Rattler and the French the Pomone — their first screw war-steamers,—and both governments ordered some of their old sailing ships to be fitted with screws. The Rattler was originally designed for a paddle steamer, but was changed to a screw soon after her keel had been laid.

Previous to making their determination concerning the Rattler, the Admiralty experimented with a screw steamer—the Archimedes,—which was built at government expense, but was not armed for naval service. The screw that propelled her was the invention of Francis P. Smith, whose patent was taken out in the same year as that of Ericsson, and who built an experimental boat about the same time. Smith obtained the speed of his screw by means of gearing, while Ericsson coupled the engine immediately to the propeller.



Hodgson's Screw Propeller.

Inventors have busied themselves in improving the form of the screw, and the varieties in use are numerous. The number of blades or arms varies from two to five or six. Probably there are more four-bladed screws than of any other form, and these are mostly in the merchant service. On naval vessels the two-bladed screw is more frequent than any other, as this form allows the screw to be lifted out of water and suspended in a "well" at the stern of the ship, when it is desired to make use only of the sails.



Ordinary Form of Screw Propeller.

The "pitch" is the distance that the screw would advance in making a complete revolution in a solid substance; the "thread" is the distance along the edge of the blade; the "angle" is the inclination of the thread of the screw to the horizon; the "area" is the surface of the blade; "length" is the fraction of the pitch that is used; "diameter" is the perpendicular distance between the extreme outside points of two blades opposite each other.

In perfectly smooth water and with just the proper immersion of a vessel, the advantages of the screw and paddle are about equal, but in rough water, where the paddles have a constantly varying immersion, it is apparent that the screw is superior. So also when the ship is lightened or deepened, the paddle will be too deeply buried or raised too much out of the water, which is not the case with the screw. For inland navigation in shallow water the paddle-wheel still holds the first place, but the screw has completely driven the paddle from the ocean. Taking into consideration all the conditions of a transatlantic voyage, of rough weather, where the paddles are alternately buried in water or whirling in the air; of head winds, where the paddle-boxes present a large resisting surface; and the greater capacity of a screw steamer for freight, it was found that the expense of a paddle steamer was nearly twice as much as that of a screw steamer of the same capacity crossing the ocean in the same time. The first successful transatlantic voyage of a screw-propelled vessel was the doom of the ocean paddle steamer.

Though not altogether confined to steam navigation in the advantages it presented, the invention of the iron ship marked an important step in advance. It was made quite early in the history of steam navigation, as a steamboat called the Caledonia was built of iron in Dundee in 1818, to run on the river between that city and Perth. Two years later an iron steamboat, the Aaron Manby, was built in sections at the Horsley Iron Works and put together in London. She went direct from that city to Paris, and was the first steam vessel to make that voyage. She was broken up in 1855, after being steadily in service for thirty-five years.

Iron steamboats followed with considerable rapidity. The names of the earliest iron steamships in the transatlantic and other ocean traffic are mentioned elsewhere.

The most energetic builder of iron steamers in the early days was William Fairbairn, of Glasgow. In 1830 and 1831 he built three iron vessels for the trade between Liverpool and Glasgow, and in the succeeding four years he built several iron steamboats and steamships intended for different routes. He then became associated with the Lairds of Birkenhead, and between 1835 and 1848 the firm had constructed upwards of one hundred first-class ships. Their example was contagious, and the use of iron in place of wood became general throughout the British Isles.

Though more expensive than wood in ship-building, it is found that iron is cheaper in the end, as an iron steamship, barring wrecking, collisions, etc., will last three times as long as one of wood, and have greater carrying capacity in proportion to her weight and displacement. In the last ten years steel has encroached upon iron and threatens to drive it out of the ship-building field. A steel ship weighs from ten to twenty-five per cent. less than an iron ship of the same displacement and speed, and consequently furnishes so much more space for the stowage of cargo.

We will now return to the history of the Cunarders.

In 1855, stimulated by American competition, the company had its first *iron* paddle steamer, the Persia which was 390 feet long, 45 feet broad on the hull, and 71 feet across the paddle-boxes. Her measurement was 1,200 tons more than that of any existing Cunarder of the time, and her owners claimed that she was by far the finest ship that had ever floated. She was built with seven water-tight compartments, and great stress was laid upon the advantages of this novel mode of construction. Its novelty is less apparent to those who have read the travels of Marco Polo and learned that the people of Cathay built their ships after this fashion six centuries ago.*

* "The Travels of Marco Polo," pages 409, 418, 419, published by G. P, Putnam's Sons, New York,

In 1862 appeared the Scotia, which was to the Persia and her compeers what the latter had been to the Britannia and Acadia. She was of iron and with paddles like the Persia, but was more splendid in her fittings and of greater dimensions. Wood as a material for ship-building was abandoned by the Cunard Company, and iron took its place, to be followed in its turn by steel. The Scotia was notable as being the last paddle steamer of the Cunard line. She was retired in the height of her popularity on account of the excessive cost of running her in comparison with a screw steamer of equal capacity. She was sold, and for a long time lay neglected at Birkenhead, opposite Liverpool. In 1879 she was bought by the British Telegraph Construction and Maintenance Company. Her paddle engines were removed, and she was fitted with twin-screw engines and sent to Asiatic waters.

The service of the Cunard Company includes the lines between Liverpool and Boston and Liverpool and New York, the latter employing the largest and newest of the company's ships. Both these lines are weekly each way throughout the year. In summer the New York and Liverpool service is semi-weekly each way. Then there is a line from Liverpool to all the principal ports of the Mediterranean; there are lines connecting Liverpool with most of the ports of the United Kingdom; steamers carrying the mails between Halifax, Bermuda, and St. Thomas; and other steamers at work in various parts of the world. Since its beginning to the present time the Cunard Company has built and owned more than one hundred and fifty steamships, and has had fifty ships in service at one time.

Note the growth in size and carrying capacity of the Cunard steamships. The Britannia measured 1,139 tons, and could carry 225 tons of cargo. The Bothnia, built in 1874, measured 4,335 tons, and could carry 3,000 tons of cargo—fourteen times the carrying capacity, with only four times the measurement. The Britannia steamed 8½ knots an hour and the Bothnia 13 knots, with less than half the amount of coal per indicated horse-power, and about the same quantity of coal for the distance run. The Persia burned six tons of coal to carry one ton of freight across the Atlantic, while the steamers of to-day will carry five tons of freight for each ton of coal consumed.

But we have not space nor speed to follow the history of all the steamers of the Cunard or any other line. With a single bound we will come down to the Umbria and Etruria—the latest additions to the fleet—and the reader will please make his own comparisons between these ocean giants and the pigmies Britannia and Acadia.

The Umbria and Etruria are sister ships, built upon the same plans, and therefore a description of one will answer for both.

The dimensions of the Etruria are:

"Length over all, 520 feet; breadth (extreme), 57 feet 3 inches; depth to upper deck, 41 feet, and to promenade deck, 49 feet, with a gross tonnage of about 8,000 tons. She is entirely built of steel throughout, and is divided into ten water-tight compartments, most of the bulkheads being carried up to the upper deck and fitted with waterproof doors, giving access from one part of the ship to the other. By this arrangement the danger of fire spreading, should it break out in any division of the ship, is removed as far as possible, and greater safety is obtained by being able to isolate any department for sanitary purposes, or in case of damage to the hull and the compartment being flooded.

"The dining saloon is 76 feet long, extending the full breadth of the vessel, the height from beam to beam being 9 feet. The saloon is arranged with a large cupola skylight, fitted on the promenade deck, the total height from the saloon floor at the cupola being over 20 feet. Altogether, accommodation can be provided for 720 first-class passengers, the largest number of which are arranged for two-berth staterooms only, and replete with all fittings usual in the highest class of passenger steamers, a number of the rooms being fitted *en suite* for family use. The greatest care has been taken in the lighting, ventilation, and sanitary arrangements throughout. The vessel is fitted with three masts, full bark-rigged.

"The boilers are of steel, like all the rest of the vessel, the hull, the crank shaft, and the more vital parts of the engine. Compressed steel was used, and in the course of the construction the closeness of the grain and the total absence of the least indication of a flaw were remarked by the many engineers who visited the works during their construction. The boilers are all "double-ended"—that is, they are provided with a set of furnaces at each end. The flame passes to a chamber in the centre, returns through the tubes, and thence to the funnel. As steamers have increased in size and speed the boiler has grown, but it has grown in circumference, not in length. A stranger to the necessities and objects of the structure would think it disproportionate, but experience has shown that a large steam space in the boiler is the best reservoir of power, and a sure preventive of priming. The engines are the most powerful in the world. They are compound, and indicate upwards of 14,000-horse power. The three inverted cylinders each connect directly with the built crank below. The centre high-pressure cylinder is 71 inches in diameter, the two low pressure are each 105 inches, They have a six-feet stroke, and turn a screw of manganese bronze of equal delicacy, strength, and accuracy of pitch. The qualities of manganese bronze, combined with the development in practice of the true proportions of the screw propeller, are computed to add upwards of a knot per hour to the performance of the old-fashioned cast-iron blades."

Before taking her place on the line, the Etruria made an experimental cruise around Ireland, running the entire distance of 805 knots in 46 hours; in one part of this trip she ran at the rate of 24 statute miles an hour. She was placed in service between Liverpool and New York in May, 1885, and during the summer made the following record:

WESTWARD.		D.	H.	M.	EASTWARD.		D.	H.	M.
May,	1885,	7,	2,	8	May,	1885,	6,	12,	39
June,	1885,	6,	22,	33	June,	1885,	6,	13,	14
July,	1885,	6,	14,	14	July,	1885,	6,	14,	6
August,	1885,	6,	5,	44	August,	1885,	6,	9,	10
					Sept.,	1885,	6,	7,	30

Her westward trip in August, 1885, was the best time made by any ocean steamship up to that date, the best previous record having been made by the Cunard steamship Oregon, in 6 days, 10 hours, and 4 minutes.

The "Etruria's" first day's running, counting from 2:26 P.M. till the following noon, was 424 knots, followed by 464, 450, 465, 464, 464, and 70 from noon to 3:35 P.M. on the day of her arrival.

The distance which she travelled shows that the Etruria maintained a speed of 21½ miles per hour continuous steaming for the entire voyage.

The best single day's run was made by the Etruria on her second voyage to the westward, on which occasion she steamed 481 nautical miles, which is equal to 557 statute miles, and required a speed of over 23 miles per hour. To accomplish this speed, the Etruria and Umbria are said to burn from 300 to 350 tons of coal every 24 hours.

The substitution of steel for iron in the building of steamers is a very great advantage. Each of the new ships of the Cunard line weighs six hundred tons less than if built equally strong of iron and with the same power and displacement. Consequently she has just so much more carrying capacity, and it is claimed that a ship of steel is less liable to injury in certain accidents than one of iron or wood. Not only the plates but the rivets are of steel, and all plates and rivets are carefully tested before use.

In 1859 Lord Palmerston recommended a baronetcy for Mr. Samuel Cunard, which was granted by the Queen. Sir Samuel left his business and title to his son Edward, who died in 1869, leaving the title to his son, Sir Bache Edward Cunard. Down to 1878 the business was conducted as a partnership, but in that year it was merged into a limited liability company in which the old partners had a very large share. For many years after its inception in 1840 the Cunard line received a heavy subsidy from the British Government for the transportation of the mails, but latterly its subsidies have been less remunerative. At one time it received from this source nearly a million dollars annually.

About 8,000 officers, sailors, stokers, and others are constantly employed on the ships of the Cunard Company, and 4,000 more on shore, at the docks, machine-shops, warehouses, and offices, or 12,000 in all. In a speech made at the launching of the Etruria, Mr. John Burns, a director of the company, said that during the previous year their ships had run the equivalent of six times the distance from the earth to the moon. Another speaker on the same occasion said the ships had carried in one direction in the year just closing no less than seventeen million letters and not a mail-bag had been lost or misplaced.

We will now leave the Cunarders and return to the early days of transatlantic navigation by steam.

The Great Britain was the immediate successor of the Great Western; her keel was laid at Bristol in 1839 and she was launched in 1843. She was originally intended for a paddle steamer, but owing to difficulty in finding a contractor to make the shafts she was changed to a propeller. By a ludicrous blunder she did not leave the Cumberland docks at Bristol for more than a year after being launched, as she was broader than the docks and unable to move until they were widened. She was released in December, 1844, and early in the following year steamed around to London to receive her cargo for New York.

The Great Britain was 322 feet long, 51 feet beam, measured 3,448 tons (old measurement), was built of iron, and had a propeller 15 feet in diameter. Her engines were of 500-horse power, nominal, and she was divided into six compartments; she was notable for being one of the first ocean steamers of iron and propelled by a screw, and on one occasion at least her compartments saved her from being a total loss. She ran for several years between England and New York, was a transport in government service during the Crimean War, afterwards ran to Australia as a passenger steamer, and in 1881 was sold to be converted into a sailing ship.

Another of the early steamers was the President, launched in 1839, and sailed on her first trip to New York in August, 1840. In April, 1841, she sailed from New York and was never heard from afterwards, nor was any trace of her wreck ever discovered. She was the first transatlantic steamer to disappear at sea; those that have followed her have been the City of Glasgow, City of Boston, Pacific, Tempest, United Kingdom, Mina Thomas, Ismailia, Rechid, Commander, Mary Church, Shannon, Anna, Trojan, Colombo, Mexican, Durley, Stamfordham, Copia, Herman Ludwig, Homer, and Zanzibar.

Several of the above-named steamers were small and did not carry passengers ; of some it is reported that they were too deeply laden for safety, and their loss is due to the greed of owners rather than to unavoidable accidents. The passenger steamers never heard from are supposed to have been destroyed by icebergs, as in nearly every instance other steamers reported great quantities of ice directly in the track of the ill-fated vessels. The President was seen under sail and not using her engines on the 23d and 24th of April, 1841. A Portuguese brig passed within three miles of her, but she made no signals of distress and appeared to be sailing about four miles an hour. This was the last ever seen of her.

Others of the early steamers in transatlantic service were the British Queen and Columbia. The latter should not be confounded with the Columbia of the Cunard line, which was wrecked near Halifax, without loss of life, in July, 1843. The first American steamer running regularly to England as a passenger packet was the Massachusetts, built by Captain R. B. Forbes, of Boston. She sailed from that city in September, 1845, and crossed the Atlantic in seventeen and a half days, using steam eleven days. She was an auxiliary-screw steamer, and her propeller was arranged so that it could be hoisted out of the water whenever it was desired to run under sails alone.

Previous to the departure of the Massachusetts, the American propeller Marmora had visited England on her way from Boston to the Mediterranean, and the paddle steamer Bangor (also American) had crossed direct to Gibraltar. The Massachusetts had a propeller nine feet in diameter, of composition metal, and her measurement was about seven hundred tons. She made two voyages to Liverpool and back, and was then chartered and afterwards sold to the government for use in the Mexican War. At the capture of Vera Cruz she was the flag-ship of General Scott. After the conclusion of peace with Mexico she was transferred to the Navy Department, and carried the flag of the United States through the Straits of Magellan to the Pacific Ocean. She was a storeship during the Civil War, and afterwards a sailing ship under the name of Alaska.

In 1841, Thomas Butler King, of Georgia, introduced a bill into Congress directing the Secretary of the Navy to advertise for proposals for American steamships to carry the mails to European ports. The bill failed of passage, but was brought up the next session, and again and again by Mr. King, until 1845, when he succeeded in securing the passage of a bill authorizing the Postmaster-General to advertise for proposals for the transport of the mails to foreign countries. This bill led to the formation of the Ocean Steam Navigation Company of New York, which began active operations in 1847 with the steamships Washington and Hermann, built expressly for the purpose.

These steamers measured about 1,700 tons each, were 224 feet long, 39 feet broad, and 29 feet deep. They ran between New York and Bremen, touching at Southampton, twice a month each way, and were to receive $200,000 yearly compensation for carrying the mails. Their average passages from New York to Cowes were 14 days, 7 hours, 17 minutes, and from Cowes to New York, 13 days, 14 hours, 53 minutes. The line was discontinued at the expiration of the contract, and the steamers were sent to the Pacific Ocean, where the Washington was wrecked and the Hermann broken up. This was the first line of steamers carrying the mails to Europe under the American flag.

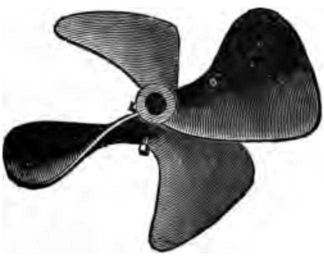
In 1848 a company was formed for a fortnightly service between New York and Havre, with a compensation of $150,000 per annum, to be performed by the Franklin and the Humboldt, the first of 2,400 tons and the second of 2,850 tons. The steamers called at Southampton both going and returning, and in conjunction with the Bremen line formed a weekly communication each way between New York and Southampton. The Franklin made her first voyage in 1850, and was wrecked on Long Island in 1854. The Humboldt began running in 1851, and was lost near the entrance of Halifax harbor in 1853. The service was continued by chartered steamers until 1855–56, when the Fulton and the Arago were completed and placed on the route. At the outbreak of the war the line was withdrawn, and the steamers were used as transports. It had been hoped that the mail-service would be resumed after the close of the war, but such was not the case. The Arago was sold to one of the South American governments, and the Fulton was used as a hospital at the New York quarantine station.

All the steamers of the Bremen and Havre lines were paddle vessels. The Fulton and Arago were practically sister ships, differing only in minor details. The following were the dimensions of the Fulton:

Length on deck, 290 feet; beam, 42 feet 4 inches; breadth over paddle-boxes, 65 feet 6 inches; depth of hold, 31 feet 6 inches, measurement, 3,000 tons; diameter of cylinder, 65 inches; length of stroke, 10 feet; diameter of wheels, 31 feet; width of paddles, 18 inches; length of paddles, 9 feet; number of paddles on each wheel,

28. The Fulton had three decks; could accommodate 300 first- and second-class passengers, and carry 800 tons coal and 700 tons freight. She had two inclined oscillating engines, and her draft, when loaded, was 17½ feet.

In his work on "Ocean Steam Navigation," Mr. Rainey says: "When one of our first American mail steamers sailed for Europe, no practical marine engineers could be found to work her engines. She took a first-class engineer and corps of assistants from one of the North River packets; but as soon as the ship got to sea and heavy breakers came on, all her engineers and firemen were taken deadly sea-sick, and for three days it was constantly expected the ship would be lost."



Four-Bladed Screw,

CHAPTER XVIII.

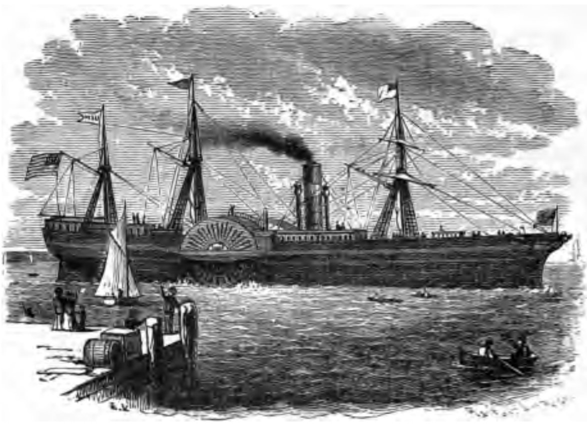
History of the Collins line—Loss of the Pacific and Arctic—Fate of the other Collins steamers—Other American steam lines—Cause of their present inactivity—The United States and Brazil line—English and French aid to steamers—American coasting lines.

ALMOST simultaneously with the Bremen and Havre lines of American steamships came the Collins line, which was at one time the object of a great deal of patriotic interest. Its inception was not unlike that of the Cunard line, but, unhappily for Americans, the parallel cannot be followed beyond a few years.

Edward K. Collins was born at Truro, Massachusetts, in 1802, and came to New York when little more than a youth. He organized a line of sailing packets between New York and Southern ports, including Vera Cruz and Havana, and the success of this enterprise led to the formation of a similar line to Liverpool. It was known as the "Dramatic Line," and the ships composing it were the Shakspeare, Garrick, Siddons, Roscius, and other famous names on the dramatic stage. The ships were an improvement upon any of their predecessors; they were known for their rapid voyages, and their accommodations for passengers were of a style of luxury hitherto unknown. They made a great deal of money for their owners, and, after the Cunard line had been successfully established, Mr. Collins determined to use some of the money which his sailing packets had earned for him in creating a line of American steamers.

He formed a company for that purpose, and, in 1847, he and his associates obtained from the United States Government a contract for carrying the mails between New York and Liverpool. They were to build five first-class steamships, and make twenty voyages a year, and for each voyage they were to receive $19,250. Afterwards the number of voyages was increased to twenty-six a year, making a fortnightly departure from each side, and the compensation was raised to $33,000 a voyage, or $878,000 yearly. Further time was given to the company to get in readiness for its work, and it was not to be required to complete its fifth ship. It was also favored with an advance of $25,000 upon each ship from the date it was launched until the whole sum should amount to $385,000. In return for this assistance the Collins line was to make quicker passages than had been hitherto made by any steamships on the Atlantic, and deliver the mails with greater promptness than they had been delivered by the Cunarders.

The first steamer of the Collins line was the Atlantic, which left New York April 27, 1849, and arrived at Liverpool May 10, making the passage in thirteen days. Two days were lost during the voyage by accidents to the machinery, and it was found impossible to run the engines at full speed on account of the danger of tearing the floats from the paddle-wheels. The Atlantic was 276 feet long, 45 feet beam, 76 feet broad over the paddle-boxes, 31 feet 7 inches deep, and her measurement was 2,860 tons. Her wheels were 36 feet in diameter, and it



The Steamship Atlantic.

was claimed that she was the largest steamship then afloat. The Pacific was built on precisely the same lines as the Atlantic; the latter was broken up at New York in 1879, and the former disappeared at sea in 1856.

The Pacific was on a westward voyage at the time of her loss, and is supposed to have been destroyed by running into an iceberg. Two hundred and forty persons were on board of her at the time, including the wife of Mr. Collins, the founder of the line.

The Arctic was the fastest steamer of the Collins line and was modelled by George Steers, the designer of the yacht America. She was 282 feet long, 45 feet wide, and 24 feet deep below the main deck. Her capacity was 2,856 tons; her cylinders were 95 inches in diameter, and the length of stroke was 10 feet. On her eighth passage from New York she made the then wonderful time to Liverpool of 9 days, 17 hours, and 12 minutes.

The average time of forty-two westward trips of the Collins line in its early days was 11 days, 10 hours, and 26 minutes; at the same period the average time of the Cunarders was 12 days, 19 hours, and 26 minutes. During the World's Fair in London, in 1851, the superior speed of the American steamers led to the following in *Punch:*

"A steamer of the Collins Line,
  A Yankee-doodle notion,
Has also quickest cut the brine
  Across the Atlantic Ocean.
And British agents, noways slow
  Her merits to discover,
Have been and bought her—just to tow
  The Cunard packets over."

On the 27th of September, 1854, in a dense fog about fifty miles south of Cape Race the Arctic was run into by the French steamship Vesta, and sunk. Of her passengers and crew five hundred and sixty-two were lost. The Baltic made several quick passages and was deservedly famous in her time. She was in government service during the Civil War, and afterwards ran between New York and Aspinwall for the Pacific Mail Steamship Company. Then she was altered to a sailing ship and made several voyages between San Francisco and Liverpool as a wheat carrier, for which she was admirably adapted. Afterwards she was bought by a German company and on a voyage from Bremen to Boston was so badly strained as to be considered unseaworthy. Accordingly she was broken up in 1880, and so ended the last of the four steamships that composed the once famous Collins line.

A fifth ship, the Adriatic, was built by the company and launched April 8, 1856, but before she was ready for service the Collins Steamship Company had failed, and the Adriatic never made a trip on the line. She was a screw steamship, 345 feet long, 50 feet wide, and 33½ feet deep. Her registered capacity was 4,145 tons. She was purchased in 1861 by the Galway Steamship Company, which had been formed with a view to running fast steamers between Galway, Ireland, and St. Johns, Newfoundland, making the transit of the Atlantic in six days. The Adriatic fully met the requirements and on a return trip to Galway she went from port to port in 5 days, 19 hours, and 45 minutes. The Galway line came to grief after a very brief existence; the Adriatic passed through various vicissitudes, and finally was relegated to use as a coal hulk, the fate of many a noble steamer that has plowed the ocean in pride.

Impelled by Congress and the American public generally, the Collins line sought to surpass all rivals in the matter of speed. The object was accomplished by pushing the ships to their best, but the cost of doing so was very great. Each of the four ships consumed from ninety to one hundred tons of coal daily, and in a statement made to Congress it was shown that it cost nearly half a million dollars annually to make the saving of a single day in the voyages to Liverpool from New York.

The original cost of the four steamers was $2,994,000; the average cost of each of the round trips in the early days was $65,215, and the average receipts $48,287. The withdrawal of the subsidy compelled the withdrawal of the line, and the building of the Adriatic completed the ruin of Mr. Collins. He died in New York in June, 1878; his funeral was attended by many men prominent in maritime matters, including representatives of nearly all the steamship lines connecting New York with foreign ports.

The history of the Pacific Mail Steamship Company has been given elsewhere. It is now the only steamship line of importance carrying the American flag to foreign ports. In the last twenty years there have been several attempts to establish lines of American steamships to Europe, and also to South America, Australia, and elsewhere, but all have failed to be remunerative. With the exception of the American line from Philadelphia to Liverpool, all the transatlantic lines belong to European nations, and of the one American line referred to, some of the ships are under the English flag. The cause is not far to seek.

The rates of taxation upon steamship property in the United States are much heavier than in other countries; materials and labor are dearer, and the wages of officers and crews are much higher. Congress, with a few spasmodic exceptions, has refused to encourage ocean navigation by mail contracts or other subsidies to American steamers. This is in direct contrast to the conduct of England towards her merchant marine, which is by far the largest in the world, and owes much of its prosperity to the liberality of the government. British steamships are taxed upon their earnings, and not upon their valuation. In a poor season, or while lying idle, there is little or no taxation, but the American ship-owner must pay the same rate upon his property at all times. England has steadily encouraged steam navigation to foreign countries, or to her distant colonies, by granting subsidies in the form of mail contracts, and the subsidies have been almost uniformly maintained until such time as the business has developed to a point where the steamers can run without government aid.

England was a country of protection until she had built up her industries to where they could compete with the rest of the world, which happened about 1840–1845. Then she threw off her protective duties and became a land of free trade, and she followed her action by demanding that all other nations should open their markets to her products. But from 1840 to the present time she has persistently protected her foreign steam marine by heavy subsidies for carrying the mails, wherever subsidies were needed. When the lines have become self-sustaining, the subsidies have been withdrawn, though there are many exceptions to this rule. England's policy in regard to steam lines has been almost the exact repetition of her policy toward British manufacturing interests previous to 1840–1845, and by careful adherence to it she has made her steam marine what it now is. She has destroyed fair competition, and obtained a practical monopoly of the construction of iron steam ships, although her conduct has been a palpable contradiction of her professions in favor of free trade everywhere.

France encourages ocean navigation not only by heavy contracts for carrying the mails, but by bounties upon the construction and equipment of steamers and sailing ships. In the case of a steamer built in France, the bounty amounts to 17½ per cent. of her total cost. On a steamer costing $250,000 the bounty amounts to about $44,000. In case of a change of boilers, provided the new ones are of French make, the owner of the ship receives a bounty of $16.00 per ton of new engines, or boilers, weighed without the tubes. In a change of boilers weighing 100 tons without the tubing, the owner would receive $1,600.

On a steel or iron sailing ship of 1,500 tons gross measurement the bounty amounts to $18,000, being at the rate of $12.00 a ton. On a wooden sailing ship of 1,000 tons gross, the bounty is $4,000, or $4 a ton. On a composite ship, of wood and iron, the bounty is $8.00 a ton gross measurement.

The bounty is increased 15 per cent. on steamers built on plans approved beforehand by the Marine and Navy Department. In case of war, merchant ships and steamers may be impressed into the government service, for which they are entitled to a fair compensation. French steamships receive a bounty for the number of miles run at sea, and for this compensation they shall carry the government mails free of charge. During the first year of the operation of the bounty system in France, 161 steamers, of 122,276 tons, were added to the French merchant marine.

Germany, Holland, Russia, and other countries encourage steam navigation by liberal mail contracts to ships bearing their respective flags, but not so the United States. The following from Admiral Preble's account of the United States and Brazil Mail Steamship Line is a good illustration of American encouragement to ocean steam navigation :

"The steamships of the United States and Brazil Mail Steamship Line (now defunct) were built by John Roach & Son, at Chester, Pa., on the Delaware, and were fine specimens of naval architecture. They were 370 feet long over all, 39 feet beam, with a depth of hold from base line to the top of spar-deck of 31 feet 6 inches, and had a custom-house register of 3,500 tons. Their mean low draft was 21 feet. They had three decks, beside the hurricane deck, from the stern extending to the after side of the main hatch. The deck-frames were of iron, and the deck-houses all iron-braced and stiffened in the most thorough manner. They had six bulkheads, dividing them into seven water-tight compartments.

"Built under the supervision of the Bureau Veritas and the American Shipmasters Association of New York, they were rendered seaworthy by the use of the best material in their construction and equipment. The machinery proper consisted of two compound surface-condensing engines, the cylinders of which were 42 inches for the high pressure, and 74 inches for the low pressure, each 60 inches stroke, 2,500-horse power, and with separate engines for working the air and circulating pumps. The six boilers were of the cylindrical return tubular type, their working pressure 90 pounds to the square inch. The propeller was a four-bladed brass one, 16 feet in diameter, of the Hirsch patent. The maximum passenger capacity was 100 first-class passengers, and 400 in the steerage.

"The whole project was the enterprise of one plucky man, John Roach, a deserving citizen, yet probably one of the best-abused men in the country. The founder of the line risked a million of his own private capital in starting a line of steamers to an empire 6,000 miles away, from which the United States buys $60,000,000 worth of goods every year, and to which it would like to sell a similar sum annually, and could, in time, if facilities for the trade are created and maintained. Previous to the starting of the line our merchants were handicapped. It was as though Boston was trying to do business with San Francisco by means of steamers sailing to Panama, while New York was trading over a direct railroad route across the continent. We had to send a long way to reach Brazil. The English traded direct. Our mails and valuable goods to Brazil had to go by way of England, taking ten or thirteen days to cross the Atlantic, having often to wait ten days in England for a steamer, and then consuming from twenty to twenty-five days in going from the British Isles to Brazil.

"When this new line from this country direct was started, facilities were created which were imperatively needed. The convenience of the line was so great that it has been frankly and cordially conceded. The steamers were well manged, and in three years never missed a trip nor failed to sail on time. By means of the line mails were sent in twenty-two days direct; and the certainty and regularity of the trips were of advantage almost to the whole American public. A wide variety of miscellaneous products were introduced, little by little, and the start of a large trade effected. In quantities of goods sold the export trade to Brazil increased constantly while the steamers ran. The line brought travellers and merchants to the country in large numbers, the exact number in the three years being about two thousand. Profitable orders and contracts were brought to this country by these travellers, which otherwise would not have been secured. There was a large reduction in freights, also, through the operation of this American line. Instead of its costing from 70 to 85 cents a bag to get coffee to New York from Brazil, the freight was reduced to 50, and even to 30 cents a bag. This commodity was brought 6,000 miles for $5 and $6 a ton, that is, at the rate of $1 a ton for a thousand miles of voyage, which is about the cheapest ocean transportation ever known.

"The saving to the United States upon the immense importations of coffee was very large. The freight on measurement goods was also lowered from 35 cents a cubic foot to about 20 cents. These reductions and the more important fact of regular and quick communication were of genuine service to the public; and it was with sincere regret that business men learned of the discontinuance of the American line. During the three years that Mr. Roach maintained the line, $1,400,000 was paid out for expenses, and $92,000 for repairs in the United States, and $300,000 for expenses abroad. And it was estimated that the business men of this country have saved $1,700,000 by reduction of South American freights during that period.

"Mr. Roach had very far-reaching plans. Could this line have received the support he sought to obtain for it, he would have built more steamers and started several other lines. The Brazilian fleet would have been enlarged, and direct trade would have been opened to other coasts. The Buenos Ayres project was only one of many in view.

"It seems a pity that the question of mail compensation to the Brazilian line could never have been discussed on its merits. Mr. Roach's appeal to Congress was not by any means entirely defenceless. He carried the United States mails 140,000 miles in 1879 for $1,875, while three coasting lines carried them unitedly 123,400 miles and got $102,800 for the service. Mr. Roach was beaten, not by the impolicy of the subsidy system, but by an organized effort, both in the United States and in Brazil, to break him down. People went from city to city with subscription papers to raise money to use against him at Washington, and the speeches made at Washington in opposition to his line were translated into Portuguese and sent to Brazil by thousands to create a coldness in official circles there against the American steamers."

In a speech before the House of Representatives April 25, 1882, while advocating measures for the relief of American shipping, Hon. Nelson Dingley used the following language:

"The efforts of England to control the ocean carrying trade ought to arouse the American Congress and people to the importance of our shipping interests. This is a question which affects the interior as much as the seaboard, the West as much as the East, the South as much as the North. It is not a local, but a national question.

"It involves the inquiry as to whether we will save to our own people the ship-building industry, which employs tens of thousands of workmen, and distributes millions of dollars; whether we shall retain a due share of the $100,000,000, which we annually pay for ocean transportation, with all the avenues of employment which it would open; whether we shall open up wider markets for American products in China, Japan, South America, and the Orient.

"It covers more than the material interests of the nation, great as these are. It involves questions affecting our commercial independence; our standing and influence as a nation; and even our national security. No nation ever maintained its national importance after it ceased to be a great commercial nation.

"To-day our commerce is largely dependent on fóreign ships; so dependent that a war in Europe would be more disastrous to us than to the belligerents themselves.

"The eyes of the country are turned to the defenceless condition of our coasts in consequence of the weakness of our navy; for it is an accepted military axiom that whatever nations command the ocean will command the coasts of countries adjacent. But a powerful navy is the offspring of a great merchant marine. Look over the nations of the world, and it will be found that navies rise and fall with their merchant marine. Great navies, it has been well said, are never built in navy-yards. The United States have eight navy-yards, and almost no navy. England has only three navy-yards, and the strongest navy in the world. Only nineteen per cent. of her vessels and marine engines were built in navy-yards, and eighty-one per cent. in private ship-yards. The fleet of English merchant iron steamships, subject to government orders in case of war, in return for the aid they receive, is in itself an effective naval force. The development of our merchant marine is the cheapest, most effective, and most beneficent policy of national defence.

"Important as are many other questions before this Congress, I hold that not one of them is of greater importance and of more far-reaching consequence than this. We are already a republic of more than 50,000,000, and increasing in population and wealth at a rate never before known in the history of any other nation. In 1890, our population will reach 65,000,000, and in 1910 it will reach 100,000,000, provided we are true to ourselves and our destiny. But, unless all history is misleading, we cannot hope to retain our present advantages, or to extend our prestige as a nation, unless, by an efficient system of protection and encouragement, we hold and strengthen our position on the sea, as we have on the land. As has been well said, the throne of empire rests no less on the rocking waves than on the solid land."

The navigation laws of the United States prevent the coasting trade from falling into the control of other nations; they are copied from the English laws, which were made in the time of Cromwell, and were maintained without important variations until very recently. The English laws provide that no ship should be deemed a British one that was not built in the dominions of Great Britain, wholly owned by British subjects, and navigated by a British commander, with a crew three fourths British. None but British ships should carry merchandise from one British port to another, and no goods produced or manufactured in Asia, Africa, or America should be imported in other than British ships or in the ships of the countries that produced them.

Many political economists believe that the rigorous enforcement of these laws during two centuries has done more than any other cause in giving England her enormous commerce. In 1849 the principles of free trade were allowed to break down this monopoly in some of its features. By an act of Parliament in that year and by later amendments, ships built elsewhere than in Great Britain may receive British registers, provided they are owned by British subjects. Any ship may bring merchandise to British ports, but it is in the power of the government to put such restrictions or prohibitions upon the ships of any country as are made upon British ships in the ports of that country.

The coasting trade of the United States is retained for vessels flying the United States flag; the rule holds good for the great lakes of our northern boundary, as well as for maritime navigation on the Atlantic and Pacific coasts. Under these navigation laws, the various lines running between northern and southern ports are free from foreign competition. The only steamship lines which Americans can "proudly call their own" are those that connect New York, Boston, and Philadelphia with Norfolk, Charleston, Savannah, New Orleans, Galveston, Havana, Vera Cruz, and other of the coast and gulf ports. The steamer business on the great lakes has been elsewhere mentioned.

Of the coasting lines, the most important are the Mallory Line, from New York to Florida and the gulf coast as far west as the Mexican frontier; the Boston and Savannah Steamship Company, whose service is indicated by its name; the New York, Havana, and Mexican Mail Steamship Company, more generally known as the "Alexandre Line," running between New York, Havana, and the ports of Mexico; the Red "D" line of steamships between New York and Caribbean-Sea ports; the Ocean Steamship Company, connecting New York and Savannah; Morgan's and Cromwell's lines to Louisiana and Texas; the Old Dominion Steamship Company, and the New York & Cuba Mail Steamship Company, running between New York and Havana weekly, and to Santiago de Cuba monthly. The last is frequently called "Ward's Line."

Most of the steamers of these coasting lines are of iron, and admirably fitted for the special trade in which they are employed. They measure variously from 1,200 to 3,500 tons, and their accommodations for passengers are excellent. Take the City of Augusta, of the Ocean Steamship Company, as an example: She has a cargo capacity of 3,000 tons, is 323 feet long over all, 40 feet beam, has five water-tight compartments and three decks. She has compound engines, with two inverted cylinders, which are respectively 42 and 82 inches in diameter. Her screw is 16 feet in diameter, with 26 feet pitch, and with six tubular boilers she works under a pressure of 100 pounds of steam. Her staterooms are unusually commodious, and she carries 100 first-class passengers without crowding.

The City of Alexandria and the City of Washington, of the Alexandre Line, have each accommodations for one hundred and fifty first-class passengers. Some of the staterooms on these steamers have been fitted with the Huston self-levelling berth, which maintains a level position throughout all the motions of the ship, and is highly prized by those to whom sea-sickness is a terror. The Newport, of the New York and Cuba line, has made the fastest time on record between New York and Havana. She has a capacity of 3,000 tons, and is an iron ship, 348 feet long and 38 feet beam. She has compound engines, with cylinders of 48 and 90 inches diameter, and 4½ feet stroke. The engines are capable of being developed to 3,000-horse power, or one-horse power for each ton of measurement. The steam pumps are so arranged that they can be connected with any part of the vessel, and are capable of throwing 1,750 barrels of water a minute.

Recently a monthly service each way between New York and Rio Janeiro, touching at Newport News, St. Thomas, Barbadoes, Para and other Brazilian ports, has been established with the iron steamers Merrimack and Finance. The managers have revived the name of the United States and Brazil Mail Steamship Company, and promise that their service will be a permanent one. This is a consummation devoutly to be wished.

CHAPTER XIX.

How the Inman Line was founded—First steamers for carrying emigrants—Steady increase in the size of ships—The City of Rome—Hamburg and Bremen lines and their origin—The Anchor Line and its latest steamship—The "French Mail"—Notes on the compound marine engine and the lengthening of ships.

THE second transatlantic steamship line yet in existence is that of the "Liverpool, New York, and Philadelphia Steamship Company," better known as the "Inman Line." It was organized by William Inman, an enterprising merchant of Liverpool, and was the first transatlantic line of iron steamships propelled by the screw. The service began by the departure of the steamship City of Glasgow from Liverpool for Philadelphia, December 10, 1850, carrying a general cargo and 400 steerage passengers. To Mr. Inman is due the credit of originating the plan of carrying steerage passengers on steamships. Before that time emigrants were excluded from steam-vessels on account of the high price of passage, and their only means of transatlantic transit was by sailing ships.

The Inman Line began without subsidies and with only one steamship. Prophecies were freely made that the projector of the enterprise would be ruined, and it is said that he had much difficulty in securing partners in the scheme. As the Cunard Line was running to New York and Boston, Mr. Inman decided to make Philadelphia his western terminus and for six years he continued to do so. One of his steamers, the Kangaroo, was frozen up in the Delaware for five weeks, and this and other reasons turned his attention towards New York. For a few years the steamers sailed alternately from New York and Philadelphia but finally the Quaker City was abandoned altogether for the more accessible port of New York.

The predictions of failure were by no means realized. The business of the single steamer City of Glasgow, which made monthly trips each way, and for the first six months composed the entire "line," was so profitable that the City of Manchester was purchased in June 1851 and doubled the fleet of the company. This steamer yielded a profit of forty per cent. in the first year of her possession by Inman and his partners; the profits together with additional capital were invested in other steamships, and step by step the line grew from a monthly service to a fortnightly, tri-monthly, weekly, and semi-weekly one. The owners actually contemplated a daily service but were cautious enough not to undertake it until justified by the volume of business.

Down to 1875 the Inman Line was a partnership affair; in that year it was formed into a joint stock association with the name of "Inman Steamship Company, Limited," its founder retaining a large interest, and his son, Ernest S. Inman, becoming manager of the line. Mr. William Inman died in 1881, and long before his death he was in possession of a large fortune, the result of his enterprise and industry. Many thousands of emigrants hold him in affectionate remembrance for the work he originated of carrying steerage passengers on steamers; other lines have taken a portion of this business, but the credit of starting it belongs to the man just named. In an article upon this subject the London *Times* said:

"Many were those who shook their heads when the 'City of Glasgow' set out on her first voyage, screw-propelled in mid-winter, when the condition of the Atlantic was thought to be perilous in the extreme; but the founder of the Inman Line had faith in his own prognostication, and from being regarded as a desperate adventurer he has become the recognized pioneer of a liberal enterprise, from which thousands of struggling families, driven to seek their fortunes over the seas, have benefited in a manner that will compare with any of the great improvements of modern times."

The quickness of transit was by no means the only advantage over the old emigrant service of the packet ships. The food was better and more liberal in quantity; rigid sanitary requirements were made; medical and official supervision was strict and constant; the moral conduct of the steerage passengers was carefully guarded; and the "tales of horror" that came from the sailing packets in former times became things only of history. But while the Inman Line made a specialty of the steerage business it did not neglect the first-class nor the "intermediate." It entered into a sharp competition with other lines for passengers of the higher grades, and though unpopular at first on account of its transport of emigrants it long ago gained a foremost place.

The early ships of this line were not famous for their first-class accommodations, and could only obtain cabin passengers by taking them at lower rates than the Cunard and Collins steamers; it steadily won its way to favor by the character of its newer ships, the vessels of each decade being larger, better fitted, and in every way preferable to those of the preceding one. And not even ten years were required for a very marked improvement, as it frequently happened that a ship which was considered the perfection of a "floating palace" on making her first voyage, was, in five years, an "antiquated tub, quite behind the age."

The most serious accidents that have befallen the Inman Company were the losses of the City of Glasgow in 1854, and the City of Boston in 1870.

Both ships disappeared at sea, and no trace of them was ever found.

The City of Glasgow was 277 feet long, 32 feet 7 inches broad, and 24 feet 7 inches deep. She was 1,600 tons burthen, with engines of 380-horse power. Compare her dimensions with those of the following, which may be taken as types of the progress of the Inman Line in successive periods :

NAME OF STEAMSHIP.	YEAR.	LENGTH.	WIDTH.	DEPTH.	TONS.
City of Manchester.	1851	262	36	25	1,906
City of Baltimore.	1854	326	39	26	2,472
City of Bristol.	1860	349	38	27	2,655
City of New York.	1865	375	40	33	3.499
City of Brussels.	1869	390	41	35	3.775
City of Montreal.	1872	419	44	34	4.489
City of Berlin.	1874	520	45	37	5.941
City of Rome.	1881	586	52	37	8 415

The last-named steamer, the City of Rome, was built for the Inman Company, but did not meet the terms of the contract in speed, carrying capactity, and consumption of coal. She was returned to the builders, and, after undergoing expensive alterations, was sold to the Anchor Line, in whose service she is now running. The company's fleet now in service comprise the latest and fastest ships, and its departures are weekly from each end of the route. The voyage is frequently accomplished inside of eight days, and the intending passenger can be assured at the company's office of "certainty, security, and celerity," in the ocean transit. Agents of steamship companies can generally demonstrate the superior speed and advantages of their vessels over those of their rivals, and it is not likely that the Inman representatives will be found wanting in this particular.

The Inman Company had great hopes of the City of Rome, which was at the time of her launch next in size to the Great Eastern, and the disappointment at her failure was in proportion to the previous hopes, as she had been expected to surpass every thing afloat. She was constructed by the Barrow Ship-Building Company. The Inman Company refused to accept her on account of her serious deficiencies in speed, carrying capacity, draught of water, and consumption of coal, and began a suit for damages. The Barrow Company agreed to take her back and pay all the expenses of the Inman Company in regard to the ship rather than let the case go into court. Since her alteration she is said to have done satisfactory service, but she has been the cause of much discussion as to the advantages or the reverse of very large steamers.

The following figures regarding the City of Rome will interest the sea-going reader:

Length over all, 586 feet; extreme breadth, 52 feet 3 inches; depth of hold, 37 feet; tonnage, 8,415; indicated horse-power, 10,000; her dead weight is 8,000, and her displacement at 26 feet draft is 13,000 tons; the cubical contents of her hold at 50 feet to the ton are 7,720 tons. She has eleven water-tight compartments formed by bulkheads, which extend to the main deck. The largest compartment is sixty feet long, and it is claimed that the trim of the vessel will not be materially altered when one of the compartments is filled with water. The steamer has four masts and three funnels; her propeller is 24 feet in diameter, driven by three sets of inverted "tandem" engines working on three cranks arranged at angles of 120 degrees with each other. With this arrangement the engine can never "catch on the centre."

The unscientific reader may skip the following details of the engines:

"Three high-pressure cylinders, 43 inches diameter; 3 low-pressure cylinders, 86 inches diameter; 6 feet stroke; diameter of crank-shaft, 25 inches; diameter of crank-pins, 26 inches; length of main bearings, 33 inches; of crank-pins, 28 inches. The crank-shaft weighs 64 tons; if it had been of iron, and solid, it would have weighed 73 tons. Propeller shafting, 24 inches diameter; hole through it, 14 inches diameter; thrust-shaft has 13 collars, 39½ inches diameter, giving a surface of 6,000 square inches, and it weighs 17 tons; propeller-shaft is 25 inches diameter, and weighs 18 tons; bedplate, 100 tons; cooling surface of condensers, 17,000 square feet; 8 cylindrical tubular boilers, with furnaces at both ends; each boiler is 19 feet long and 14 feet diameter, with steam-receiver 13 feet long and 4 feet diameter; each boiler has 3 furnaces at each end, or 48 furnaces in all; furnaces, 8 feet 9 inches diameter; fire-bars, 6 feet long, giving a grate-surface of 1,080 feet; boilers are constructed for a working pressure of 90 pounds to the square inch; engines are intended to work at 8,000-horse power, but can be developed up to 10,000."

Working at three-quarters speed, with 45 revolutions a minute, the City of Rome made 15½ knots per hour on her trial trip. The maximum speed is 60 revolutions, which will give a velocity of 18 knots. Her coal consumption is variously stated, but is probably much in excess of three hundred tons daily. In accommodations for passengers, the City of Rome is fully up to the standard of excellence that could be expected in a ship of her size. She is longer than either the Etruria, Umbria, or Servia, of the Cunard Line, but less wide and deep; consequently her interior measurement is about the same as that of those giants of the deep.

The service of the Inman Line steamers was suspended during the Crimean War, as the three steamers it then possessed were chartered for transports by the French Government. On the conclusion of peace with Russia the service was resumed, and, though several of the company's steamers have since been engaged at different times in the transport service of the British Government, there has been no suspension of the transatlantic work.

The Hamburg-American Packet Company, performing a weekly service between New York and Hamburg, touching at Plymouth and Cherbourg, was organized in 1847 with a line of sailing ships. The establishment of the Inman Line with its accommodations for steerage passengers threatened to destroy the business of the sailing packets, and in 1855 the German company built two steamers, the Hammonia and Borussia. The Crimean War caused a demand for neutral transports, so that the two steamers were chartered to the French and English governments, and did not go into service as transatlantic packets until 1856. The Borussia was the pioneer of the line, reaching New York on the 16th of June of that year. The Hammonia followed a fortnight later, and as fast as other steamers could be put on the old sailing packets were withdrawn. The line was popular from the start, as the company was already well known through its sailing ships.

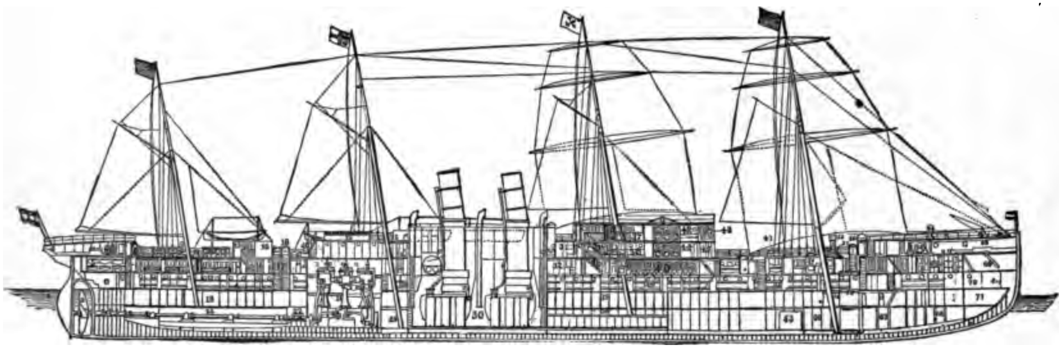
The Bavaria and Teutonia were the immediate successors of the Borussia and Hammonia. They were respectively of 2,273 and 2,034 tons, built of iron, and propelled by screws. Then followed the Saxonia, of 2,404 tons; then the Germania, and then, in 1867, came a new Hammonia, of 2,967 tons, the old one having been withdrawn and sold.

In the same year appeared the Cimbria, about the size of the new Hammonia, and in 1868 the Holsatia and Westphalia, the latter of 3,500 tons, and the former nearly as large. In 1869 the Silesia was added to the fleet, and in 1870 the Thuringia. Since then the Frisia, Pommerania, and Suevia have been placed on the route, the last-named and the largest, on the list measuring 360 feet long, 41 feet beam, and 26 feet deep. Her measurement is 3,624 tons.

In addition to its New York line, the company has a line from Hamburg to the West Indies and Aspinwall, and it still maintains its fleet of sailing ships for voyages to the Pacific Ocean and Asiatic waters in general. In 1873 some enterprising merchants of Hamburg started a rival service to New York, known as the Eagle Line, and composed of magnificent steamers. It proved a losing operation from the start, and was eventually bought up by the Hamburg-American Company. Some of the Eagle steamers are now used on the New York route, and others have been sold at an enormous reduction from the original cost.

Two years after the arrival of the Borussia at New York as the pioneer of the Hamburg Line, a company of merchants of Bremen established the service known as the North - German Lloyds. Bremen is commercially a rival of Hamburg, and the merchants of the two cities vie with each other in enterprises of a maritime character. Each had a line of sailing ships to New York, and when Hamburg established a steam line there was nothing for Bremen to do but follow its example. Hence the North German Lloyd Steamship Company, which has its head-quarters at Bremen, and runs between Bremerhaven and New York, touching at Southampton and Havre.

In the twenty years following its inception in 1857 the steamships of this company made over twenty-five hundred voyages across the Atlantic and carried nearly seven hundred thousand passengers, of whom one hundred and eight thousand were in the first cabin. At present there is a weekly service between New York and Bremen, and the company also has a line from Bremen to New Orleans. The Hamburg and Bremen lines have each between twenty-five and thirty steamers, and maintain a pretty active competition, though the managers are shrewd enough not to ruin business by reducing prices of freight and passage below a remunerative point. The steamers of both companies are built in England, nearly all on the Clyde, and the descriptions of those of one company will answer, in general terms, for those of the other. A distinctive feature of the Bremen line is the naming of the steamers after German rivers—probably because they run rapidly—but this rule is not inflexibly kept. Students of the geography of



Sectional View of a North German Lloyd Steamship.

the Teutonic empire will recognize the natural watercourses of the country in the appellations of the Bremen steamers Oder, Mosel, Rhein, Main, Donau, Elbe, Weser, Werra, and others.

The newest steamers of the Bremen line are the Elbe, Werra, Eider, Ems, and Fulda. The Eider and Ems are about 7,000 tons gross register, and measure 455 feet in length, 47 feet in breadth, and 38 feet in depth. The Werra and Fulda are about 6,000 tons gross register, and of the following dimensions: length, 455 feet; breadth, 46 feet; depth, 37 feet. The Elbe is about 5,000 tons gross, and measures 445 feet in length, 45 feet in breadth, and 36 feet 6 inches in depth. In the interior and exterior arrangements and fittings the steamers are very much alike. All the deck work is constructed either of teak or iron. With a view to protect the vessels from heavy seas, strongly constructed iron turtle-backs are placed over both ends of the ships. In the centre of the upper deck is a promenade deck about 180 feet long and the whole width of the ship, solely appropriated to the use of first-class passengers. In addition to the accommodations for the officers and crew, 170 in number, the vessels are designed to carry 150 first-class and 150 second-class, besides the steerage passengers.

The engines are of the compound three-cylinder type, with one high-pressure cylinder and two low-pressure, having a stroke of five feet, and propelling the vessels at the average of seventeen knots an hour. The crank-shafts are entirely of Krupp's crucible cast-steel, built up of several pieces on a system insuring almost absolute safety from breakage.

"Betwixt and between" the Hamburg and Bremen lines in 1855 and 1857 came the Anchor Line, which was started in 1856. History repeats itself in the inception of steamship lines and the careers of their originators. The stories of Vanderbilt, Cunard, and Inman find a parallel in the story of the founders of the Anchor Line.

There were four Scotch boys at Glasgow in 1830 or about that year, who began active life in fishing and coasting smacks; from these they graduated into schooners, and so on through all the grade of vessels till they arrived at steamers, became their commanders and eventually their owners. They formed the firm of Handyside & Henderson, which established the now famous Anchor Line. Recently the firm name has become Henderson Brothers.

Their first maritime adventures as a business firm were in the Mediterranean fruit trade with small sailing vessels. Then they bought the steamer Inez de Castro, and then another small one. They converted the sailing ships John Bell and Tempest into auxiliary steamers, and with them started the Anchor Line in 1856. The Tempest was the pioneer of the line, and—like the City of Glasgow, the pioneer of the Inman Line—she was lost at sea with all on board. The Tempest sailed from New York for Glasgow on the 11th of February, 1857—her second return trip,—and was never heard of afterwards. The dread word "missing" must be placed after the names of two other steamers of the Anchor Line—The United Kingdom and Ismailia; the former having disappeared at sea in 1869 and the latter in 1873.

Beginning business with the John Bell and Tempest in 1856, the Anchor Line grew so rapidly, that within fifteen years it had built seventeen steamers for its transatlantic service and thirty more for the Mediterranean. At present it has a regular weekly service between New York and Glasgow, and another in summer between New York and Liverpool. At different times it has had a service between New York and London, which is maintained or suspended according to the exigencies of business. Then it has a fortnightly line from Glasgow to the principal ports of the Mediterranean, and some of its Mediterranean steamers continue their course to Bombay, and occasionally to Calcutta and Singapore.

Like the other steamship companies the Anchor Line has increased from time to time the size, speed, and accommodations of its vessels, according to the demands of the period and the operations of rivals. The Tempest—the pioneer of the line—measured less than 800 tons. The steamers that immediately succeeded her were of larger size, and these again were succeeded by others still larger. Each year saw a hundred tons and more added to the size of steamers until, in 1872 (sixteen years after the advent of the 800-ton Tempest), came the California of 3,208 tons, a length of 362 feet, and engines of 1,047-horse power. Then followed the Bolivia, 4,000 tons; the Anchoria, Circassia, and Devonia, each 4,200 tons; the Belgravia, 5,000 tons, and lastly, the Furnessia, 6,500 tons. The Furnessia is 445 feet long, 45 feet beam, 35 feet deep, and when loaded to 26 feet of water, her displacement is 9,900 tons. Her engines are 3,500-horse power, and her propeller is 20 feet in diameter. The Furnessia is brig-rigged and has two smoke-stacks, and at the time of her launching, in 1881, she was the largest ship that had been built in England, with the exception of the Great Eastern. As stated elsewhere, the City of Rome now belongs to the Anchor Line.

The other lines now running between New York and the ports of the Old World do not belong to the pioneer or experimental times of ocean steam navigation, as all have been started within the last twenty-five years, after the business became a fixed fact, and there was no longer the smallest question of the success of navigating the Atlantic with steam-propelled vessels. We will consider the most important of these lines in the order of their antiquity.

The "Compagnie Generale Transatlantique," better known to Americans as the "French Mail Line," was established in 1862, and maintains a weekly service between Havre and New York with large and powerful steamships. It has also a line to the West Indies and Aspinwall from Havre, another to the West Indies and Mexico from St. Nazaire, and smaller lines through the Mediterranean. Altogether, it employs some sixty or seventy steamers and receives a liberal subsidy from the French Government for the transportation of the mails.

Its service to New York began with steamers of about 2,500 tons. In a few years these vessels were replaced by steamers of about 3,500 tons (the Pereire, St. Laurent, Ville de Paris, Lafayette, and Washington), and later these were followed by the Amerique, France, Labrador, and Canada, of 4,500 tons. Now these last are being withdrawn to make way for the Normandie, Champagne, Bourgogne, Gascogne, and Bretagne. The Normandie was built in England and measures 6,300 tons with 7,000-horse power. The other new steamers are from the company's ship-yards at St. Nazaire, under the new French bounty system, and are claimed to be second to no other steamships afloat. The description of one of these French-built steamers will answer for all, as they differ in only a few unimportant details.

The La Champagne, the first of the above new ships, was the largest steamer ever built in any French ship-yard for the merchant marine. She is entirely of steel, and has four complete decks, with a roomy poop-deck and whale-back forecastle connected by a bridge-deck amidships, making a promenade of 492 feet. She has two elliptical funnels and four masts, the fore, and main-mast rigged for square sails.

She has a double bottom, divided into tanks, holding a capacity of 650 tons for ballast. The dimensions of the La Champagne are as follows: length, 508 feet 9 inches; breadth, 59 feet 5 inches; depth of hold, 43 feet 6 inches; mean draft loaded, 24 feet 6 inches, with a corresponding displacement of 10,045 tons. The capacity for cargo in the hold alone will be 1,950 cubic tons. The capacity of the coal bunkers will be 1,677 cubic tons (stowing 1,800 tons coal). The La Champagne has superior accommodation for 300 cabin passengers, and also for 900 steerage passengers. She is fitted with every improvement for the comfort and safety of passengers. The saloons and cabins are lighted by electric lamps, and annunciators connect with the steward's department from each room. Twenty-four of the staterooms on each ship are fitted with single berths, a great blessing to those who dislike to share the restrictions of a cabin with any one else. It is to be hoped that other companies will follow the example of their Gallic competitors.

The engines of the La Champagne develop 8,000 indicated horse power, and give a speed of 18 knots per hour. The engines are of the triple expansion style, and have six cylinders; they are among the most powerful of this type, and are estimated to work with less consumption of coal than any engines previously in use. The boilers are entirely of steel, stamped for a pressure of 120 pounds. There are 36 furnaces, of 41 inches diameter. One of the great advantages claimed by the French mail agents is that passengers for the Continent avoid the discomforts of crossing the channel and the transfer by railway, thus saving much time, trouble, and expense. Recently they have advertised that a special fast train starts from alongside the steamer upon its arrival at Havre, and connects at Paris with trains for interior points of Europe.

The National Line, running between New York and Liverpool, was started in 1863 with the iron screw steamers Louisiana, Virginia, and Pennsylvania, one of them measuring 3,000 tons and the others 3,500 each. In 1864 the Erin, Queen, and Helvetia, about 4,500 tons each, were added to the fleet, and in 1865 came the England and Denmark, the former of 4,900 tons and the latter of 3,724. In 1868 the Italy, 4,169 tons and 500-horse power, was brought out, and she is worthy of note as the first transatlantic steamship on which compound engines were used. The Egypt, 4,670 tons, and Spain, 4,512 tons, followed in 1871, and the Canada and Greece of about the same tonnage a year latter.

With the increase of its fleet the Company added a New York and London line to its service in addition to the original one between New York and Liverpool. At the beginning of its enterprise and for a long time afterwards the National Line ran its ships upon the principle that safety was the first consideration and speed the second, and no effort was made to build up a record for quick passages. Nevertheless, several of its ships repeatedly made the voyage from Queenstown to Sandy Hook inside of nine days, and as they combined good accommodations with a reputation for prudence, they obtained considerable popularity among the many travellers to whom an extra day or two on the ocean was not a hardship. The company insured its own ships and gave to the captains and officers of each steamer an extra compensation yearly when there were no accidents to their discredit.

The captains are instructed to take a southerly course in the season when ice may be expected, and at other times to keep well to the south of the Virgin

Rocks. The following paragraph is taken from the Instructions to Commanders :—

"The commanders, while using every diligence to insure a speedy voyage, are prohibited from running any risk whatever that might result in accidents to their ships. They must ever bear in mind that the safety of the ships and the lives and property on board is to be the ruling principle that must govern them in the navigation of their ships, and no supposed gain in expedition or saving of time on the voyage is to be purchased at the risk of accidents. The company desires to establish and maintain the reputation of the steamers for safety, and expect such expedition on their voyage as is consistent with safe navigation."

Recently the company has added to its fleet the fast steamer America, which was specially built for its service, and it promises other and equally fast ships in the future.

The America is built of steel and is of the following dimensions :—Extreme length, 480 ; extreme breadth, 51¼ feet ; depth of hold, 36 feet ; gross tonnage, about 6,500 tons. She is divided into thirteen compartments by complete transverse bulkheads, extending to the upper deck in all cases but two. The builders guaranteed a speed of 18 knots an hour, equal to 21 geographical miles. On her passage from Glasgow she even excelled this speed. The engines are three cylinder compound, one 63 inches, and two 91 inches, with a stroke of 66 inches. They are fitted with piston valves on all the cylinders.

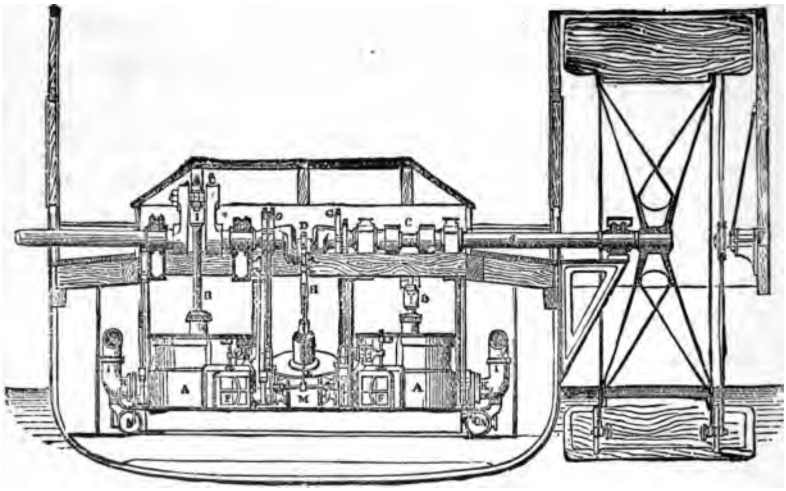
The boilers are seven in number, having thirty-nine furnaces in all, and a working pressure of 95 lbs.

The passenger accommodations of the America are of the most approved character, and the ship is lighted throughout by electricity. The saloon is 51 feet long and extends the whole width of the ship, and the nine dining tables have a seating capacity of 250.

We will leave our chronological account for a short time to consider two of the most important steps in ocean steam navigation,—the compound engine and the increased length of ships in proportion to their width.

The steamboat was not possible with the engine of Newcomen, on account of the great space it occupied and the large amount of fuel it consumed for a given amount of power. When James Watt attached the condenser to the Newcomen engine, in 1763, and substituted the pressure of steam for that of the atmosphere, in the downward course of the piston, he opened the way for the inventions of Fitch and Fulton. Admitting steam on both sides of the piston, he doubled the power of the engine, and by condensing the steam in a separate condenser, instead of cooling the cylinder at every pulsation, he made a still greater economy. Year by year the steam engine was improved, and when the machinery of the Clermont was ordered from Boulton & Watt, of Birmingham, an immense progress had been made over the apparatus of Newcomen.

The list of improvements in the steam-engine since the beginning of the century would be tedious to the general reader, and besides many of them would have no special bearing upon the problem of steam navigation. Those who wish to be further informed on this subject are referred to special works by Bourne, King, Thurston, and others, and to the article on "steam" in any good cyclopedia.



Oscillating Marine Engine. Transverse Section Through Vessel.

Watt's engines were worked with a pressure of from six to ten pounds of steam above that of the atmosphere. The condenser gave an additional pressure of fifteen pounds, as it created a vacuum by condensation of the steam, so that the entire power of a Watt engine may be computed at the pressure of steam in the boiler added to that of the natural atmospheric pressure. In England and the eastern parts of the United States, the early steamboats were fitted with condensing engines—low pressure—while those of the Mississippi and Ohio rivers had no condensers, but discharged the steam directly into the air. The latter were, and still are, known as high-pressure engines. Scientists have objected to the terms low and high pressure, but they are certainly more comprehensive to the ordinary mind than the more appropriate appellations of condensing or non-condensing engines. The reader who does not care to trouble himself with particulars may determine for himself that the engine which discharges steam by "puffs" into the air is a high-pressure one, while that which does its work in comparative silence and without emitting steam is a low-pressure affair.

Fairbairn's "Useful Information for Engineers" contains the following:

"Notwithstanding the variety of forms into which it has been moulded, the steam-engine is still the same machine in all its simplicity of principle as when it came from the hands of Watt; it has the same reciprocating action, the same principles of separate condensation, and the same mechanical organization as it had in 1784. What can exceed in beauty of contrivance the parallel motion, the governor, and other motions by which this wonderful machine is rendered effective? Innumerable attempts have been made at its improvement, and yet, with the exception of working high-pressure steam expansively, and by this means economizing fuel, there has been no change in the principle of the steam-engine, either in its condensing or non-condensing form. It is still the engine of Watt; his name is stamped as indelibly upon it as Newton's upon the law of gravitation."

Newcomen's was a beam engine and so was Watt's, but the latter was the more complete of the two. The beam as it was found in Watt's engine became the "walking-beam" of the steamboat. It was first known as a "working-beam," and the corruption of "working" into "walking" was by no means difficult. The "cross-head" engine was generally adopted on the other side of the Atlantic and followed by the "side-lever" engine. The "working-beam" engine has become the peculiar property of the United States, and it is as popular here as it is unpopular abroad.

Passing by several minor improvements in the steam engine, since the days of Watt, we will come at once to the great improvement which has been of immense importance to marine navigation,—the compound engine.

In the compound engine steam at a pressure of from 60 to 100 pounds is admitted to the high-pressure cylinder; after performing its work there it is admitted to the low-pressure cylinder, where it is employed over again as in the ordinary condensing engine. The high-pressure cylinder is much smaller than the low-pressure one; the steam is used twice, that from the top of the smaller cylinder going to the bottom of the larger one, while that from the bottom of the smaller goes to the top of the larger. By means of a surface condenser the steam is reduced to water and returned to the boilers, where it is again converted to steam and may be used over and over again indefinitely. Latterly nearly all the large steamers built for the merchant service are provided with engines on the triple-expansion system.

The principle of the compound engine was long discussed but not practically tried until after 1865. It was immediately found that there was a saving in coal of not far from forty per cent. over the condensing engines then in use. From that time all new steamers were fitted with compound engines, and in many cases arrangements were made for taking out the old style of engines from ships already on the water and substituting the compound. Not only was there a saving in the cost of fuel but the reduction of the quantity to be carried on a voyage gave greater space for freight and passengers, and required fewer men to manage the fires, supply coal to the firemen, and hoist out cinders. A comparison of the performances of the modern steamers with the early ones has been made in the account of the Cunard Line.

Compound engines were introduced into the British Navy in 1870. In 1871 Chief-Engineer King of the U. S. Navy, made a strong report in favor of the compound engine, and stated that the Fairfield Works on the Clyde had completed 130 sets of compound engines and had 22 others under construction, all for ocean steamers. The Secretary of the Navy ordered that all U. S. steamers hereafter constructed, or old steamers requiring new engines, should be supplied with those of the compound pattern. The order remains unchanged to this day.

The lengthening of ships is a progressive step of great importance in ocean navigation, and while ships have been made much longer than formerly the shape of the bow has been greatly changed. The round, swelling bow is the type of the ship of former times, and even down to the days of many persons by no means old. Builders felt that the head of the codfish and the whale formed good models for ships, and as those inhabitants of the sea were rounded in front their outlines were adopted and followed for a very long time. About 1832 Mr. Scott Russell designed what he called "wave lines" for the bow of a ship, obtaining his idea from the shape of a wave set in motion at the flow of water from the discharge of a lock of a canal. The lines of the stern he formed by studying the refilling or following wave, and when his lines were tried upon ships they were found to give increased speed.

In place of the convex bow of the ships of former times we now see a concave surface, giving it the shape of an elongated wedge, slightly hollowed on its face, by which the waters are more easily parted and thrown aside. This wedge shape is extended a long distance aft and sometimes beyond the centre of the ship; formerly the broadest part was about one third of the distance from the bow to the stern, but it is now reversed in a great many instances, even when the old proportions are retained above the water-line.

The old proportions of length to width were as four to one, as will be found by examining the measurements of English and Dutch ships of two or three centuries ago. In the early part of this century the proportions were changed to about five to one, and later to six to one. From this there has been a steady change, until now the proportion is ten or eleven to one. Note the following table, showing the change of proportion in successive years, and with steamers having a transatlantic reputation.

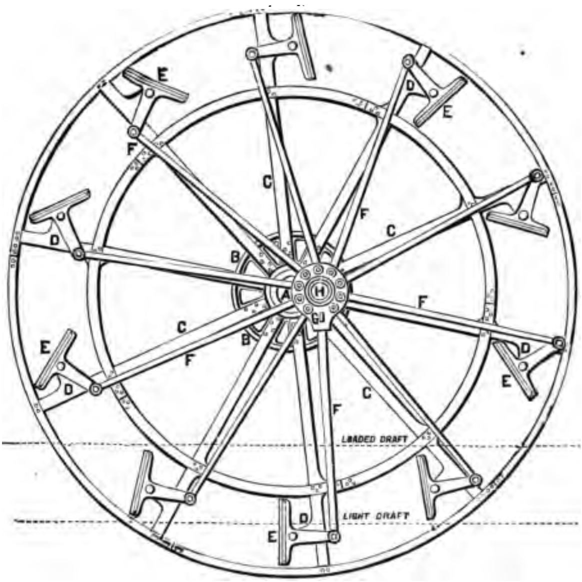
Name of steamer.	Year built.	Length in feet.	Breadth in feet.	Proportion of length to breadth.
Britannia	1840	207	34	6 to 1
Asia	1850	266	40	$6\frac{1}{2}$ " 1
Persia	1855	376	45	$8\frac{1}{8}$ " 1
City of Bristol . . .	1860	349	38	9 " 1
Russia	1867	358	42	$9\frac{1}{2}$ " 1
City of Berlin . . .	1874	489	45	$10\frac{4}{5}$ " 1
City of Rome . . .	1881	586	52	11 " 1

Since the City of Rome was built there seems to have been a pause in the effort to ascertain how long it is possible to make a ship and have her hold together. It was predicted that these very long ships would break in two in heavy seas, but this does not seem to have been the case. Many of the ships built previous to 1870 have since been lengthened, and in some cases as much as two hundred feet have been added to the length. It is not done by building on at the bow or stern, as might be supposed, but by placing the ship on the ways, cutting her in two near the middle, drawing the two sections as far apart as is desired, and then building a new section into the open space. It is claimed that a lengthened ship is just as strong as a new one. Quite likely this is the case with iron ships, as the material admits of thorough riveting and bracing, but it would hardly follow with a ship of wood.

The practical advantages of long ships over short ones are in the carrying capacity proportioned to consumption of fuel with equal rates of speed. Perhaps some enterprising genius will follow the theory, which has thus far proven correct, until we shall have steamers a mile or two in length with no more beam than the Alaska or Etruria. It is the general opinion of ship-builders and commanders that the limit of length to breadth has been reached, or very nearly. It is not likely that any one will venture beyond the proportions of twelve to one, but in this progressive age no prediction is entirely safe.

When Fulton was planning his steamboats his proposal to use wheels met with much opposition.

Many long-headed men thought that the angle at which the float enters and leaves the water, pressing it down in the former case and lifting it in the other, would cause such a loss of power that the boat would make very little advance as the wheels turned. The success of the Clermont demonstrated the incorrect-



The Feathering Paddle-Wheel.

ness of their theories, but it continued to be evident that the wheel with fixed floats was operated under some disadvantages. The continued study of this subject led to the invention of the "feathering" paddle-wheel.

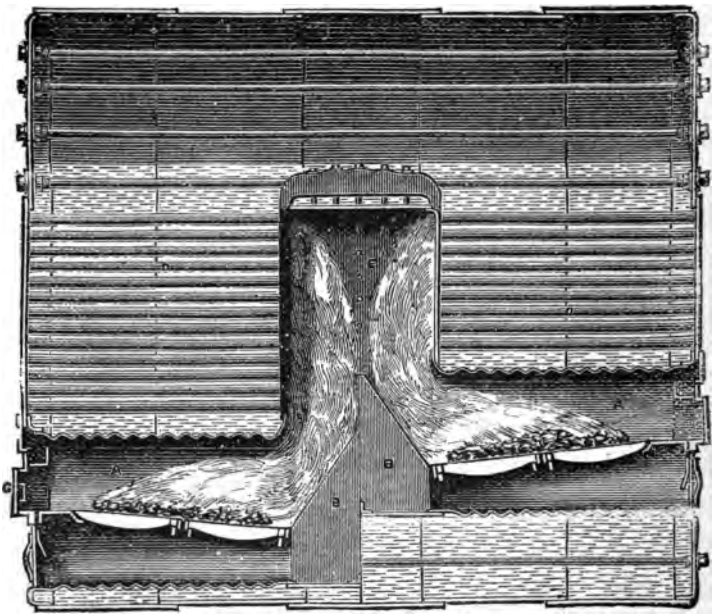
By means of this wheel the floats or buckets present a perpendicular surface to the water, or very nearly so, during all the time of their immersion. It has been found that a feathering wheel has the same action on the water as a wheel of twice its diameter with fixed arms. There is a considerable economy in space, cost, and weight, but in spite of these advantages the invention has not obtained the popularity which might naturally be looked for.

CHAPTER XX.

The Guion Steamship Line—The Greyhound of the Atlantic—The White and Red Star Lines—The Monarch Line and its largest passenger—Other Transatlantic lines—Origin of the "P. & O." Company—Its Growth and Extent of its Service—The Messageries Maritimes—German line to Asia and Australia—Other great lines—The Ocean Tramp—Ocean Steam-Tonnage of the World.

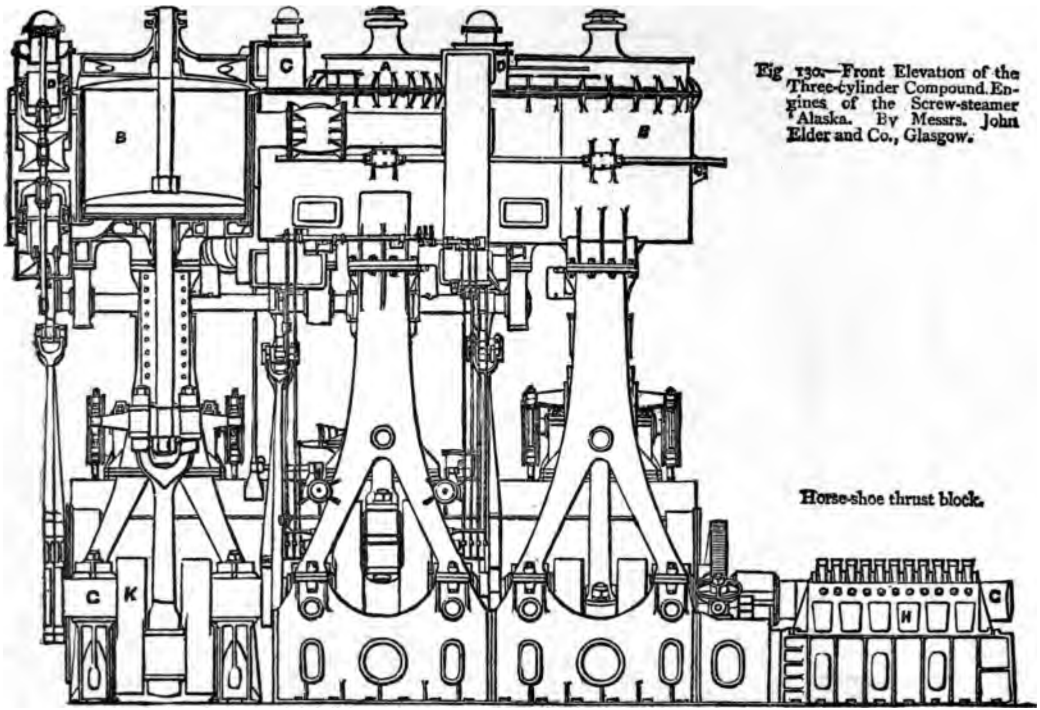
IN August, 1866, the iron screw-steamer Manhattan sailed from Liverpool for New York as the pioneer of the Williams & Guion line of steamers, popularly known as the Guion Line, and having the corporate title of the "Liverpool and Great Western Steamship Company." The Minnesota, Nebraska, Colorado, Idaho, Nevada, Wisconsin, rapidly followed the Manhattan, all iron steamers of about 3,000 tons burthen and without reputation for speed or the ability to make it. In 1873–74 came the Montana and Dakota of about 3,500 tons each, somewhat more speedy than the steamers of the old type, but still unequal to the Inman and Cunard boats.

With a view to making quick voyages over the Atlantic the Guion Company built three new steamers, the Arizona, Alaska, and Oregon, which were brought out in the order named. The Alaska speedily made a reputation by distancing all competitors and obtaining the appellation of "The Greyhound of the Atlantic." She is 526 feet long, 50 feet broad, and 40 feet deep, and her measurement is about 8,000 tons. Her engines are compound with three cylinders, inverted; the high-



Vertical longitudinal section of one of the nine boilers of the "Alaska."

pressure cylinder is 68 inches in diameter, and the two low-pressure cylinders 100 inches each, and the length of stroke is six feet. The boilers supply steam at 100 pounds pressure and she burns nearly if not quite 300 tons of coal daily. The indicated



Engines of Steamer Alaska.

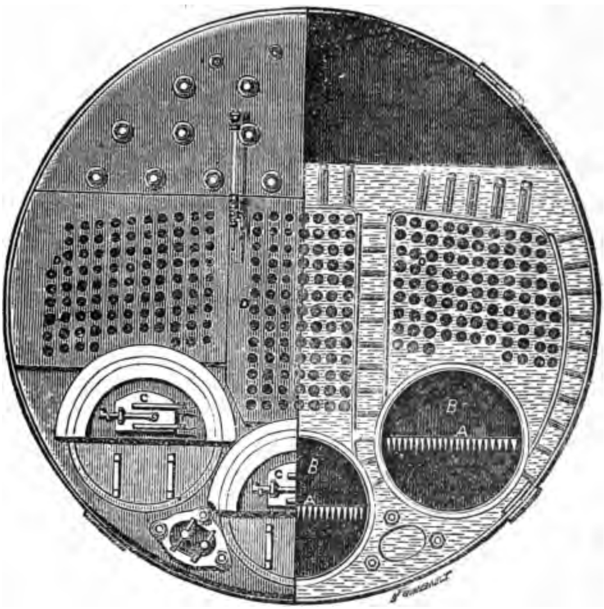
horse power is about 1,000. The ship has seven decks and two smoke-stacks; has accommodations for 340 first-class passengers, 60 second-class, and 1,100 steerage, and her main saloon can seat 280 people at once.

The Arizona and Oregon were so nearly like the Alaska that a particular description is unnecessary. The Oregon was sold to the Cunard Company owing to some disputes between the Guion Company and the builders of the ship, but both before and after her possession by that ancient association of mariners she made a high reputation for speed in crossing the Atlantic. In March, 1886, she was sunk near Fire Island, in consequence of a collision with a coal-laden schooner, and was a total loss.

The following are some of the records of these steamers:

In the beginning of July, 1882, the Alaska made the run from Queenstown to New York in seven days, five hours, and in seven days, one hour home. She then accomplished the wonderful performance of crossing in six days, eighteen hours, and thirty-seven minutes from bar to bar. The Oregon was then added to the Guion fleet, and she lowered the record to six days, ten hours, and ten minutes. During this voyage the fastest consecutive three days' running was made. She sailed from Queenstown at noon on April 13th, and arrived at New York on Saturday, April 19th, at 5.47 P.M., having run 2,861 miles. On April 17th she ran 470 miles; 18th, 469; and 19th, 472—or 1,411 nautical miles in three days.

Though not equalling the Alaska, the Arizona is a very fast ship, having repeatedly made the transit in little more than seven days. The Oregon's quickest



Half Front View and Half Cross-section of One of the Nine Boilers of the Alaska.

trip was six days, ten hours, and four minutes—the fastest on record until the Etruria appeared on the scene.

In 1870 the White Star Line of steamships burst upon New York like a meteor—the Oceanic being the first to arrive in port. Few had heard of the new line, but very-speedily the papers were filled with descriptions of the Oceanic and of the vessels that followed her. They were built for speed and superior accommodation to passengers. The main saloon was amidships, instead of in the stern, as was then usual, and it was not inclosed by staterooms, but extended the entire width of the vessel. In place of the old-fashioned benches or settees at the tables, each person had a chair to himself, and could enter or leave without disturbing any one else. The staterooms were likewise amidships at either end of the saloon, and the smoking-room was not the little hole of former days, but a comfortable and well-lighted apartment.

The ships of the White Star Line were built at Belfast, and vary from 3,700 to 5,000 tons in burthen. The company has adopted the distinctive termination of "ic" for the names of its ships, and the public is familiar with Germanic, Britannic, Oceanic, Baltic, Celtic, Republic, Gaelic, Arabic, Belgic, Adriatic, and Coptic. Varying in details, there is a general similarity of these ships, and the description of one will suffice. We will take the Coptic as an example, and the following are her dimensions:

Length, 430 feet; width, 42 feet; depth of hold, 34 feet; registered measurement, 4,368 tons; but she can carry about 6,000 tons. She is propelled by two double-cylinder engines (compound) of 450-horse power at 90 pounds pressure of steam. She has three double elliptic boilers with four fires to each, and the boilers have been tested to 180 pounds. The hull is divided into eight compartments, and the ship is lighted throughout by electricity.

The following are amongst the most remarkable passages of the steamers of the White Star Line:

QUEENSTOWN TO NEW YORK.			Days.	H.	M.	NEW YORK TO QUEENSTOWN.		Days.	H.	M.
Germanic,	Apr.,	1877,	7	11	37	Feb.,	1876,	7	15	17
Britannic,	Aug.,	1877,	7	10	53	Dec.,	1876,	7	12	41
Celtic,	July,	1879,	8	4	25	June,	1879,	8	0	0
Baltic,	Sept.,	1879,	8	0	6	Dec.,	1880,	8	1	13
Republic,	Sept.,	1881,	8	1	20	June,	1881,	8	4	34
Britannic,	Aug.,	1883,	7	13	39	June,	1883,	7	17	0
Britannic,	Aug.,	1884,	7	17	22	Oct.,	1884,	7	12	17
Adriatic,	Aug.,	1884,	8	1	22	Nov.,	1884,	7	20	43

The Red Star Line is under the Belgian flag, and subsidized by His Majesty, the King of the Belgians. It was established in 1873, to perform a weekly service between New York and Antwerp, and is under the same management as the American line from Philadelphia. The names of its steamers end in "land." Some of them are new, while others are former favorites which grew old in the service of the Cunard Line, and were sold, lengthened, transformed, and re-christened. The

Waesland is the old Cunarder Russia, the Zeeland is the Java, and the Pennland is the Algeria. The steamers vary from 3,000 to 5,000 in tonnage, and from 330 to 445 feet in length. They make the voyage between Antwerp and New York in from 10 to 14 days, and are fairly popular with those who patronize them. Some of the new steamers of the Red Star Line have made the voyage inside of 9 days, but this rapidity is not usual.

In 1874 was established the "Royal Exchange Shipping Company" of steamers, better known as the Monarch Line, on account of the nomenclature of its steamers. They are intended more for freight than for passengers desiring rapid transit. The passenger accommodations are for 1,000 in the steerage, and 60 to 100 in the cabin, and the ships have a capacity of about 4,000 tons. The steamers are the Assyrian, Norman, Danish, Celtic, Roman, Persian, Egyptian, Lydian, and Grecian Monarchs, and are as much alike as the traditional "peas in a pod." The Assyrian Monarch has brought to America the largest passenger ever carried on a transatlantic steamer,—the illustrious (and by children much lamented) elephant Jumbo.

The Wilson, Thingvalla, Rotterdam, State, and a few other regular and irregular lines plying between New York and ports of northern Europe, are devoted more especially to freight and steerage passengers, though all have first cabins, and are suited to the wants of travellers with shallow purses, and without the desire of an all-consuming speed. An Italian line to Gibraltar, Marseilles, and Genoa, offers opportunities to those who wish to go direct to the Mediterranean, and the steamers are of a size and capacity that leave little to be wished. Steamship lines rise and fall, and while this book is going through the press new ones may come into existence, or some of those now on the list may close their business and retire from the watery field.

Boston boasts of an old-established steamship service, the Warren Line, which succeeded to the business of the once famous group of sailing packets belonging to Enoch Train & Co. Its first vessels were the Propontus, Bosphorus, Delaware, and their sisters, followed in 1872 and succeeding years by the Minnesota, Victoria, Palestine, Canopus, Pembroke, Missouri, and Kansas. The last named have a capacity respectively of 4,400 and 4,500 tons, and are about 425 feet long, with compound engines of 300-horse power.

The Allen and Dominion lines are Canadian institutions, the former dating from 1854, and the latter from a much more recent year. The Allen Line grew out of a line of sailing packets very much as did the Cunard and the Hamburg lines. Its originator, Mr. Hugh Allen, was knighted by the queen as a reward for his services, and became Sir Hugh Allen. He was born in Scotland, 1810, and died December 9, 1882. At the time of his death, he was not only at the head of his steamship company, but was the president of one of the largest banks in Canada, and of twenty-two other public companies, in all of which he had large investments.

The steamers of the Allen and Dominion lines run from Liverpool to Quebec and Montreal in summer, and to Halifax in winter when the St. Lawrence is closed by ice. The transatlantic part of the route is much shorter than that from New York or Boston, but it is more dangerous on account of the numerous fogs that prevail and the high latitudes through which the vessels pass in the season of icebergs. The Canadian lines have a greater number of casualties to their account than any others, but in spite of these mishaps the service has been profitable and continues with exemplary regularity.

Turn we now to the other side of the Atlantic and note the great steamship lines that connect Europe with the rest of the world, exclusive of North America.

First and foremost is the Peninsular and Oriental Steam Navigation Company, familiarly known as the "P. & O." But where does the name come from?

In 1834 the Dublin and London Steam Packet

Company chartered the steamer Royal Tar to carry to the Spanish peninsula the mail, which had hitherto been carried by sailing packets between Falmouth and Lisbon. In the following year the single steamer grew into a "line" of two steamers, and in 1837 "The Peninsular Company of Steam-Packets" was established and made a contract to carry the mails for a compensation of £29,000 per annum. The Iberia, the pioneer steamer of this line, sailed in September, 1837, and she may be considered the pioneer of the vast fleet of the P. & O. Company of the present day.

Up to September 1840 the mails to and from India were carried by steamers monthly between Bombay and Suez, and in government steamers between Alexandria and Gibraltar, where they connected with the mail service of the Peninsular Company to and from England. In 1840 the British Government contracted with the Peninsular Company to run a line of steamers direct between England and Alexandria, touching at Gibraltar and Malta. The steamers Oriental (1,600 tons) and Great Liverpool (1,540) were the pioneer ships of this service, and the new company was called "The Peninsular and Oriental Steam Navigation Company," a name it retains to this day, though the conditions of its service have greatly changed in the forty-five years that have elapsed.

With the expiration of each contract the company extended its service in frequency, speed, and distance—until now it resembles Briareus with its many arms, its route covering the map of all Asiatic and Mediterranean waters. It has a weekly service from London to Alexandria over the original route and another from Venice and Brindisi to Alexandria; the weekly service is continued to Bombay, and there is a fortnightly service from Suez and also from Bombay to Ceylon. At Ceylon steamers diverge in three directions, one line to Calcutta, another to Singapore and Hong-Kong, and a third to Australia. At Hong-Kong there is another divergence, one line going to Shanghai and another to Yokohama, the latter city being 11,247 miles from London and the former 10,497. The Australian line terminates at Sydney, 11,978 miles from the starting point.

The company has a heavy subsidy from the government for the transportation of mails and is under severe penalties for delays. From two steamers of 1,600 tons each, its fleet has grown to sixty and more, some of them of five or six thousand tons capacity and capable of steaming at a rate such as the Oriental and Great Liverpool never dreamed of. It gives employment to nearly 13,000 persons, exclusive of coolies and other laborers on shore, and its possessions in ships, wharves, etc., are said to be worth more than twenty millions of dollars.

The P. and O. works amicably with another steamship company of equal magnitude and importance, the *Messageries Maritimes*, better known to English-speaking Asiatics as the "French Mail." It was created by the French Government in 1851, and was known as the *Messageries Imperiales* until 1870 when it assumed its present title, in consequence of the course of political events in France. It has lines through the Mediterranean, lines to India, China, Japan, and Australia, and a line to South America, touching all the principal ports from Para to Valparaiso. On its Asiatic routes it alternates with the steamers of the P. & O. Company, so that as each line runs its vessels fortnightly the mail is served weekly. Its Australian line diverges from Singapore instead of Ceylon, and runs to Brisbane, in Queensland, which is not touched by the P. & O. Its fleet equals that of the P. & O. in numbers, size of ships, splendor, speed, and every thing else, and a goodly part of its first-class passenger business is from Englishmen who consider the French ships superior to their own.

While this chapter is in preparation word comes from Germany that the government of that empire has made a contract with the North German Lloyds Company to establish lines of steamers of the highest class to Japan, China, Australia, and the Islands of the Pacific. Germany has designs upon the East, and desires colonies like those of her powerful neighbors. The P. & O. and the M. M. will thus have a new and keen competitor in the trade of the far

East, and it is possible that other governments will not be idle spectators of the commercial combat. Russia has a subsidized line of steamers—the Russian Company of Navigation and Commerce—with head-quarters at Odessa and lines through the Black and Mediterranean seas, the latter extending as far as London. Austria has the Austrian Lloyds, with a fleet of eighty or more ships, and a service covering the Levant and the Black Sea, and extending beyond Egypt to India and the Straits. Austria and Russia can easily increase their subsidies, and the directors of the companies would be only too happy to contend with England and France for their share of the Oriental trade.

Holland has a line from Amsterdam to Batavia, in Java, touching at Gibraltar, Naples, Suez, and Aden. Italy has a powerful company, the Florio-Rubattino, which possesses altogether nearly a hundred steamers. It has its head-quarters at Genoa, and sends its vessels all through the Mediterranean, and also to North and South America and to India and the Straits. Probably before this book appears we may hear of an Italian line to China and Japan, and another to Australia, as the managers are enterprising and the Italian Government is liberal ; but the subsidized lines do not have things all their own way as there are several lines running through the Mediterranean and into Asiatic waters, which have only their earnings to rely upon, with perhaps some concessions for carrying local mails along the coasts they visit.

Of these companies may be mentioned the British India Steam Navigation Company, which runs from London to Kurrachee, at the mouth of the Indus, and thence diverges up the Persian Gulf to the mouth of the Euphrates and Tigris, down and around the coast of India to Bombay, Colombo, Madras, and Calcutta, then down the coast of Burmah and the Malay peninsula to Rangoon and Singapore. Then there is the City Line, running fortnightly between Liverpool and Calcutta, the Hall Line, to Bombay, the Glen Line and the Castle Line performing a nearly similar service, the latter extending its trips to China and Japan, the Holt Line, running regularly between London and China, and the Ducal Line, which runs to Bombay and Calcutta.

Of other lines having numerous ships and performing excellent service may be mentioned the Orient Line from London to New Zealand and Australia, whose latest steamers are among the best afloat: the Pacific Steam Navigation Company from Liverpool to the ports of the Pacific Ocean by the way of the Straits of Magellan; the Royal West India Mail Line; the Liverpool, Brazil and River Plate Line; the Union Steamship Company, which divides with the Castle Line the service to the Cape of Good Hope and the east coast of

Africa; the African Steamship Company and the British and African Steam Navigation Company which supply the west coast of Africa; the Hamburg South-American Steamship Company to Brazil, and the Kosmos Steamship Company from Hamburg to Valparaiso. Other lines might be named but the list is becoming tedious and we will come to a full stop, ere the reader's brain becomes an ant-hill of the dimensions and names of ships, and bursts with the pulsation of their engines.

There remains the Ocean Tramp, which is to the organized steamship interest what the terrestrial tramp is to modern civilization. As the name indicates the marine tramps have no fixed routes but run wherever freights can be had and generally accept terms far lower than those demanded by the regular lines. For this reason they are not loved by the established companies and their characters are not painted in glowing colors. Old and unseaworthy steamers are sent out as tramps, often under heavy insurance; they founder at sea, and are reported "missing," the owners recover their insurance and the public speedily forgets all about them. Too many of the ocean tramps are of this sort, and so great has become the evil that energetic measures have been taken in the British Parliament for the protection of the lives of seamen who may perish victims to the greed of owners.

But there are other tramps that deserve to be called respectable; they are large, strong, well-equipped steamers, and belong to enterprising and careful owners who make a business of seeking freights where they are in greatest abundance. Several of the companies have thirty or forty steamers, each and many of them own from four to a dozen. In spite of their honesty of management they cannot win the favor of the regular organizations on account of their cheapening of freights, and one of the tramp companies has been derisively designated as "The Forty Thieves" in disrespectable allusion to the number of its vessels.

Following is a table showing the ocean steam-tonnage of the world, including only ships of at least 100 tons register. It is taken from the records of the Bureau Veritas, the recognized authority of the American Shipmasters' Association.

		TONNAGE.	
FLAGS.	NO. OF STEAMERS.	GROSS.	NET.
British	4,852	6,464,362	4,159,003
French	505	750,061	498,646
German	509	566,697	410,064
American . . .	355	545,187	357,269
Spanish	314	363,908	237,500
Dutch	174	214,538	143,991
Italian	147	201,070	128,146
Russian	210	161,110	105,802
Norwegian . . .	266	141,452	103,792
Danish	177	135,344	89,957
Austrian . . .	102	130,477	93,043
Swedish	311	130,180	91,228
Belgian	60	108,207	73,700

FLAGS.	NO. OF STEAMERS.	TONNAGE. GROSS.	NET.
Japanese	102	94,985	59,306
Greek	50	52,878	43,573
Brazilian	82	46,965	30,795
Egyptian	31	35,662	22,613
Chilian	22	23,766	15,511
Portuguese	23	22,299	14,624
Mexican	13	18,285	11,621
Argentine	22	14,590	8,782
Chinese	8	10,710	6,804
Turkish	14	10,144	6,270
Peruvian	6	6,789	4,639
Hawaiian	9	4,529	2,662
Haytian	5	4,087	2,529
Zanzibar	2	2,828	1,750
Uruguay	4	2,396	1,507
Tunisian	2	1,762	1,204
Roumanian	3	1,666	1,102
Venezuela	3	838	540
Costa Rican	2	719	425
Siamese	2	547	351
Ecuador	1	329	249
San Domingo	1	167	103
Total	8,394	10,269,504	6,719,101

It will be observed that American steamers stand fourth on the list, and that Great Britain possesses more than one half of all the ocean steam-tonnage of the globe. Statistics of the river, lake, harbor, and other inland steam-vessels of the world are not at hand. The total number of steam-vessels in the United States at the last report accessible to the writer was 5,401, with an aggregate measurement of 1,465,909 tons. Consequently, our ocean-going steam-vessels exceeding 100 tons register are about one fifteenth of our entire number.

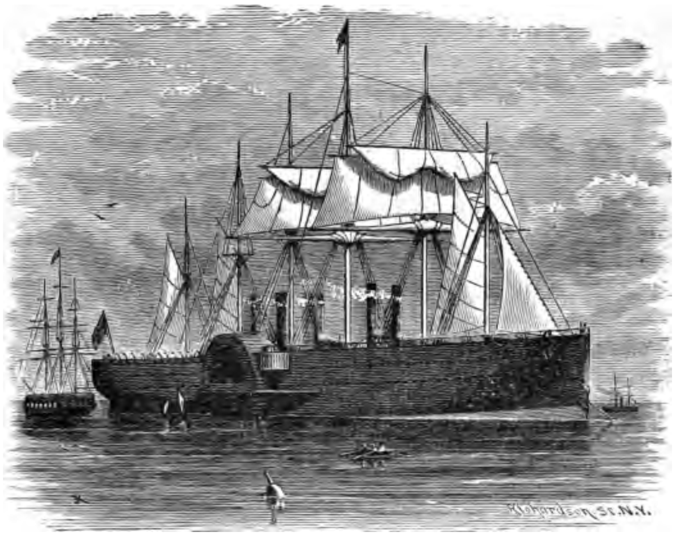
At the same ratio the whole world would possess 125,910 steam-vessels of all kinds—a numerous family, indeed, to be descended from the Clermont in less than eighty years! But this estimate is not a fair one, as the number of inland steam-vessels in the United States is doubtless much larger than that of any other country, owing to our immense network of navigable lakes and rivers. Including ocean vessels of all kinds, together with steamers navigating lakes and rivers, and the thousands of steam ferry-boats, tugs, tenders, etc., it is safe to say that not less than fifty thousand steam-vessels are now afloat in the commercial service of the globe.

CHAPTER XXI.

The Great Eastern: her history, achievements, and failures—A ghost-story—The cable steamers Faraday, Hooper, and Minia—The Anthracite and her peculiarities—Winans' "cigar-ship"—Captain Lundborg's invention—The Castalia, Calais-Douvres, and Bessemer—A steamer "nearly all wheel"—The doomed steamer Meteor—The Stiletto.

A STEAMER that has filled numerous pages of history and emptied the pockets of numerous owners is the Great Eastern—a conception of the famous engineer, Brunel. His idea was that a steamer could be built to carry coal for a voyage to Australia and back, but to accomplish this she must be very large. His calculations were that she should be from twenty to twenty-five thousand tons measurement, and should have both paddle-wheels and screws for propulsion, together with sails for use when the wind favored.

The Eastern Steam Navigation Company was organized to carry out his scheme with a capital of £1,200,000 and power to increase to £2,000,000. The first plate of the vessel was laid at Millwall on the Thames, May 1, 1854. The ship was built with an inner and outer skin two feet ten inches apart, with longitudinal and perpendicular webs or plates at intervals of six feet, so that the space between the skins was divided into sections six feet square. If the outer skin should be damaged, the water would be stopped by the inner one; if both were punctured, the water was to be kept from doing serious damage by means of twelve compartments, into which the ship was divided by transverse bulkheads. In addition to these there were two longi-

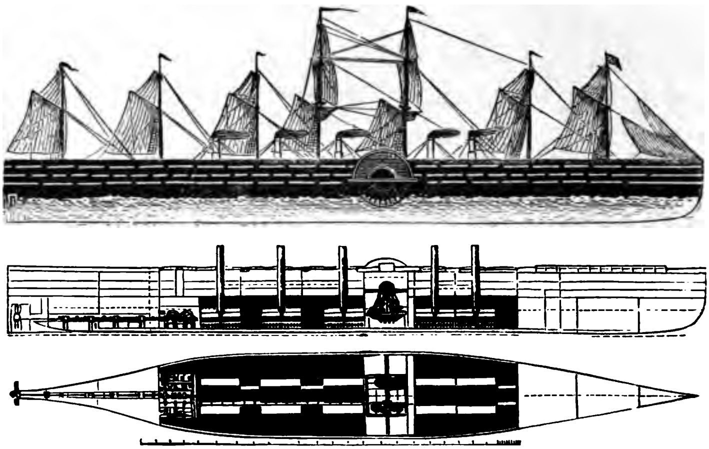


The Great Eastern at Sea.

tudinal bulkheads extending for a length of 350 feet and rising from the bottom of the ship to the upper deck. The iron plates of which the skins were made were three-quarter inch in thickness, except the keel plates, which were one inch thick. The vessel was built parallel with the river, as it was intended to launch her sidewise.

About eight thousand tons of iron were used in the hull, and the estimated weight of the whole vessel with every thing and everybody on board was estimated at 25,000 tons.

November 3, 1857, an attempt was made to launch the ship, but after moving six feet she stuck on the ways. After several unsuccessful attempts to move her, she slid into the water January 31, 1858, and



Plan of the Great Eastern.

was christened the Great Eastern by Miss Hope, daughter of the chairman of the company.

Brunel had estimated the cost of building and launching the ship at £500,000, but his figures were exceeded by £230,000. In November, 1858, the Eastern Steam Navigation Company was dissolved and "The Great Ship Company" was organized with £330,000 capital. The new company was to pay £160,000 to the old one, spend £120,000 in fitting and finishing the ship, and have £50,000 for working expenses.

The following details of her dimensions, capacity, fittings, power, etc., will be interesting to the nautical reader, and repay a glance on the part of those who do not "go down to the sea in ships."

SUMMARY OF STATISTICS OF THE "GREAT EASTERN."

Length of upper deck	feet, 692
Length between perpendiculars,	" 680
Breadth across paddle-boxes	" 118
Breadth of hull	" 83
Depth from deck to keel	" 58
Number of decks	4
" " masts	6
Diameter of "	2 ft. 9 in. to 3 ft. 6 in.
Quantity of canvas under full sail, square yards	6,500
Number of anchors	10
" " boats	20
Tonnage (old measurement),	tons, 22,500
Storage for cargo	" 6,000
Capacity of coal-bunkers,	" 12,000
Draught of water, unladen,	15 ft. 6 in.
" " laden	feet, 30
Number of water-tight compartments,	12
Diameter of paddle-wheels	feet, 56
Weight " "	tons, 185
Length of floats	feet, 13
Width "	" 3
Number of floats to each wheel	30
Length of paddle-shafts	feet, 38
Weight " "	tons, 30
Length of intermediate cranked shafts	feet, 21½
Weight of intermediate cranked shafts	tons, 31

PADDLE-ENGINES.

Nominal horse-power	1,000
Number of cylinders	4
Diameter "	6 ft. 2 in.
Weight " including piston and rod	tons, 38
Length of stroke	feet, 14
Strokes per minute	14

PADDLE-ENGINE BOILERS.

Number of boilers	4
Furnaces to each	10
Length of boilers	17 ft. 6 in.
Width "	17 " 9 "
Height "	13 " 9 "
Weight of each	tons, 50
Weight of water	tons, 40
Area of heating surface	sq. feet, 4,800
Number of tubes	400
Thickness of plates	⅜ and 7/16 in.

SCREW PROPELLER.

Diameter of screw	feet, 24
Pitch "	" 37
Number of fans	4
Weight of screw	tons, 36
Length of propeller-shaft	feet, 160

SCREW ENGINES.

Nominal horse-power	1,600
Number of cylinders	4
Diameter of each cylinder,	inches, 84
Length of stroke	feet, 4
Number of revolutions per minute,	50

SCREW BOILERS.

Number of boilers	6
Funnels to each boiler	12
Length of boiler	18 ft. 6 in.
Width "	17 " 6 "
Height "	feet, 14
Weight of boiler	tons, 57
" water	" 45
Area of heating surface	sq. feet, 5,000
Number of tubes	420
Thickness of plates	7/16 and ½ in.
Number of auxiliary engines	4
" donkey-engines	10
Total horse-power (about)	12,000

PASSENGER ACCOMMODATION.

Number of passengers (first class),	800
" " (second class),	2,000
" " (third class),	1,200
Aggregate length of saloons and berths	feet, 350
Number of saloons	10
Length of principal saloon	feet, 100
Width " " "	" 36
Height " " "	" 13
Length of cabins	" 14
Width "	7 to 8 ft.
Height "	7 ft. 4 in.

Admiral Preble asserts that Noah's Ark was smaller than the Great Eastern, and gives the following figures, taking the cubits of Sir Isaac Newton and Bishop Wilkins as the standard of measurement of the biblical vessel:

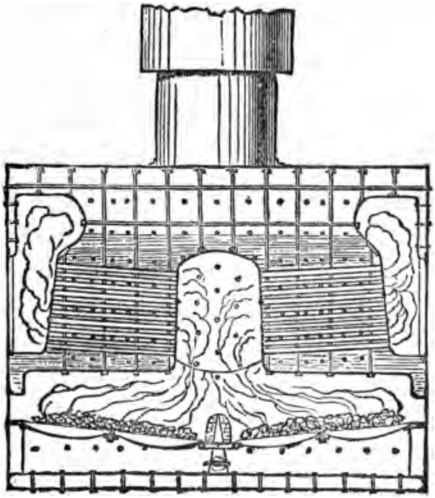
	NOAH'S ARK, ACCORDING TO NEWTON. Feet.	NOAH'S ARK, ACCORDING TO WILKINS. Feet.	GREAT EASTERN. Feet.
Length bet. perpendiculars,	515.62	547	680
Breadth . . .	89.94	91.16	83
Depth . . .	51.56	54.70	58
Keel or length for tonnage,	464.08	492.31	630.02
Tonnage according to old law	18,232	21,762	28,093

Sir Isaac Newton makes the Scripture cubit 20 and $\frac{62}{100}$ inches; Bishop Wilkins makes it 21 and $\frac{68}{100}$ inches. The reader may adopt whichever standard he chooses and still he will find the Great Eastern larger than Noah's Ark. Not only was she larger than any previous ship but she was the only one with two sets of paddle-engines and two of screws.

Compare this steamer of thirty years ago with one of the recent triumphs of marine architecture, the City of Rome.

	LENGTH. Feet.	BREADTH. Feet.	DEPTH. Feet.	CAPACITY, TONS. NET.	GROSS.
City of Rome .	586	52	37	3,453	8,144
Great Eastern .	680	83	58	13,344	18,915

By September, 1859, the Great Eastern was ready for sea, and left her moorings at Deptford for Portland Roads. On the way an explosion occured by which ten firemen were killed and many persons injured. After repairs were completed she went to Holyhead, where she arrived October 10th, and afterwards went to Southampton where she wintered. Captain Harrison, her commander, was drowned in



Boiler of the Steamer "Great Eastern."

the Solent, in January 1860, and she was placed in command of Captain Vine Hall.

She made her first voyage to New York in June 1860, with 38 passengers and 8 guests. Her best day's run, during the voyage, was 333 miles, and the best speed attained was 14½ knots per hour. She consumed 2,877 tons of coal on the voyage, which began on the 17th and ended on the 28th of June.

The ship attracted a great deal of attention at New York, and her consignees decided to send her on a voyage to Cape May and back, at the price of ten dollars a ticket. Several hundred passengers embraced the opportunity, and, according to all reports, were very glad to get back to the Metropolis. There was more motion to the ship than many of them had expected, and those who neglected to carry a supply of provisions were unable to obtain sufficient to eat.

After being exhibited in New York, for an admission fee of twenty-five cents, the Great Eastern sailed for England on the 16th of August, and crossed the Atlantic in ten days. On reaching her native land she fell into the hands of the sheriff, and was not released until the following spring. She made three or four trips to New York in the summer of 1861, suffering severely in a gale on the 12th of September, when many of those on board thought she would go down. In 1862 she resumed her transatlantic business, terminating her season by running on a rock near Long Island, and springing a serious leak. Repairs took some time and she did not return to Liverpool until January, 1863.

She ran to New York a few times in the following summer. In 1864 she was bought by Glass, Elliott & Co., and chartered to lay the Atlantic telegraph cable. Alterations required much time and expense, and in July, 1865, the Great Eastern steamed away with the cable on board and safely carried it to the

American shore. Landing the end of the cable she started for Ireland. The cable broke in mid-ocean and after vainly trying to grapple it the Great Eastern returned to England.

In the following year she took out a new cable which was successfully laid; then she went back to where the previous year's cable was broken and after much effort brought up the end, spliced it to what she had left on board and started for Ireland, where she arrived safely. It seemed as though the Great Eastern had found her mission at last.

In 1867 she was fitted up by a French company for conveying passengers from America to the Paris Exposition of that year. She was prepared for two thousand on her first voyage but only 191 offered. Several sailors were killed or wounded by an accident to one of her capstans, and after the voyage the ship again went into the courts through a suit of her crew for their wages.

After that adventure the Great Eastern laid four or five cables across the Atlantic, and also the cable from Bombay to Suez. A few attempts were made to utilize her for carrying freight and passengers but none were successful, and the British Government several times refused to purchase her for a transport. Most of the time she has lain idle in English harbors, obtaining a small revenue through the fees collected from visitors, but never has she paid a dividend to her stockholders. The original builders sunk all their capital and so did the stockholders of the Great Ship Company; those who chartered her for laying the cables may have obtained some remuneration, but, it is safe to say, their enterprise never returned them a fortune.

In 1881 the Great Eastern was offered at auction, but withdrawn when it was found that she would bring no more than £30,000. In October, 1885, she was again offered and sold for £26,200. It was the intention of the purchasers to load her with coal, send her to Gibraltar, and keep her there as a coal hulk, a use for which she is admirably fitted.

> "Imperial Cæsar, dead and turned to clay,
> Might stop a hole to keep the wind away."

The total cost of the Great Eastern, including hull, engines, fittings, furniture, etc., was $4,703,575.

From the time she stuck on the ways during the launch she seems to have been unfortunate, but happily her misfortunes, while serious for stockholders, captain, and crew, did not extend to her passengers. She was in advance of the needs of commerce, as there was not a sufficient movement of passengers and freight at any one time to ensure her a cargo of the latter and a complement of the former. Now the needs of commerce have changed, but the compound engine, unknown in her time, and the vastly superior models of the present day, render the Great Eastern as useless for ocean navigation as would be the ark of Noah, to which she has been compared.

There is a tradition handed down among all the sailors that have formed the crews of the Great Eastern that her ill luck is due to an accident which occurred while she was in process of building. The story goes, that on one occasion two of the workmen became intoxicated and crept into one of the incompleted spaces between the two skins of the ship. While they were sleeping off the effects of their carouse the plate to complete the inclosure of the space was put into position and riveted down and the absence of the men was not noticed or accounted for for several days. The ghosts of these victims of their own drunken carelessness are said to haunt the ship, and their fellow workmen predicted that whenever the Great Eastern should be broken up two skeletons would be found in one of the inclosures of that enormous cellular tissue, where they have lain and been transported wherever the vessel has gone.

As a layer of ocean cables the Great Eastern was superseded by the Faraday, which was built in 1873 expressly for that purpose. She is 366 feet long, 52 feet beam, 36 feet deep, and measures 5,000 tons gross. She can carry 6,000 tons dead weight of cable which is contained in three iron tanks occupying a large part of the interior of the vessel. Like the Great Eastern the Faraday has a double bottom, partly to give additional strength and support the tanks, and partly in order that the space between the skins may be utilized for taking in water ballast as the cable is paid out. Bow and stern are built alike, and there is a rudder at each end of the ship. She has two engines each working a screw independent of the other, and by means of the rudders and screws the ship is enabled to turn as if on a pivot, a great advantage in her especial work.

The Hooper is a cable steamer similar to the Faraday, and there is a smaller one called the Minia which is constantly kept in Halifax or St. John's. The Minia is about 3,000 tons burthen and her work consists in keeping the cables in repair. She carries about 600 miles of cable constantly in her tanks and is fitted with all the apparatus necessary for picking up, undermining, or splicing a damaged cable. The several transatlantic cables keep her well occupied.

The smallest steamer that ever crossed the Atlantic is, or was, the Anthracite, with a gross measurement of 70 tons, and a registered measurement of 28 tons. She was 84 feet long, and of this length 22½ feet were occupied with engines, furnaces, boilers, and coal-bunkers. She was the invention of Mr. Loftus Perkins and was built in England to demonstrate the advantages of steam at an enormously high pressure. The boilers of the Anthracite are of horizontal tubes welded up at each end and connected by a vertical tube, and were tested to a pressure of 2,500 pounds to the square inch. On her transatlantic voyage (in 1880) the Anthracite steamed 3,316 miles in 22½ days ; she did the entire distance with 25 tons of coal, steaming 1,353 miles with only nine tons. Most of the time she used only one ton per day.

Mr. Perkins thus describes his invention, which he illustrated in the Anthracite :—

"An anti-friction alloy is used so that no lubrication is required. Cylinders with piston-rings of this material have been in use for several years without showing signs of wear; the only wear being on the rings, which are easily replaced. Not only is the cost of oil or greese saved, but the destructive action on the machinery and boilers of the acids generated from lubricants is avoided.

"For the use of steam at these high pressures three different sized cylinders are employed, all jacketed with spiral tubes cast in the metal, which are supplied with steam direct from the boilers, and keep up the temperature of the cylinder. The cylinders are arranged one above the other, and their pistons are connected to a common piston-rod. The operation is as follows:

"The high-pressure steam is introduced into the upper end of the first cylinder where there is no gland, and where the piston is formed so as to require no lubricating material. The steam is cut off at half-stroke in this cylinder, and when admitted for the return stroke into the bottom of the second cylinder, of four times the area. The temperature is so much reduced as to cause no difficulty when brought into contact with the piston-rod gland. From the bottom of the second cylinder the steam expands into the top of the same cylinder, which is of larger capacity than the bottom, and serves as a chamber, and is in direct communication with the valve-box of the third cylinder. This last is double-acting and is arranged to cut off at about a quarter-stroke, and at the termination of the stroke exhausts into the condenser, with an expansion of about 32 times."

In 1866 Ross Winans, an American who had acquired fame and fortune in connection with railway enterprises in Russia, built in England a steam vessel of peculiar model which was generally known as the "cigar ship." It was pointed at both ends and was intended to go through the waves rather than over them. The inventor claimed that on this model a vessel of large capacity, suitable for traversing the Atlantic, could cross from Liverpool to New York in five days. A high speed was attained on the trial trip and a larger steamer was built, but she never attempted to traverse the broad ocean.

The same idea had been developed by Joseph W. Morse, of Brooklyn, and by Captain Perry Bliven, the inventor of the dome steam-yacht Meteor. The latter is 158 feet over all; 136 feet at water-line; and 129 feet on the keel; 21 feet beam; 17 feet deep, and measuring 512 tons; she draws 6 feet forward and 11 feet aft. The sides are continued upwards and over so as to form a dome, whence the name of the peculiar model. The boat is intended to be much deeper aft than forward, and the inventor's idea is that the waves will break over the bow and sloping sides and readily flow off instead of weighing down the deck as in ordinary ships.

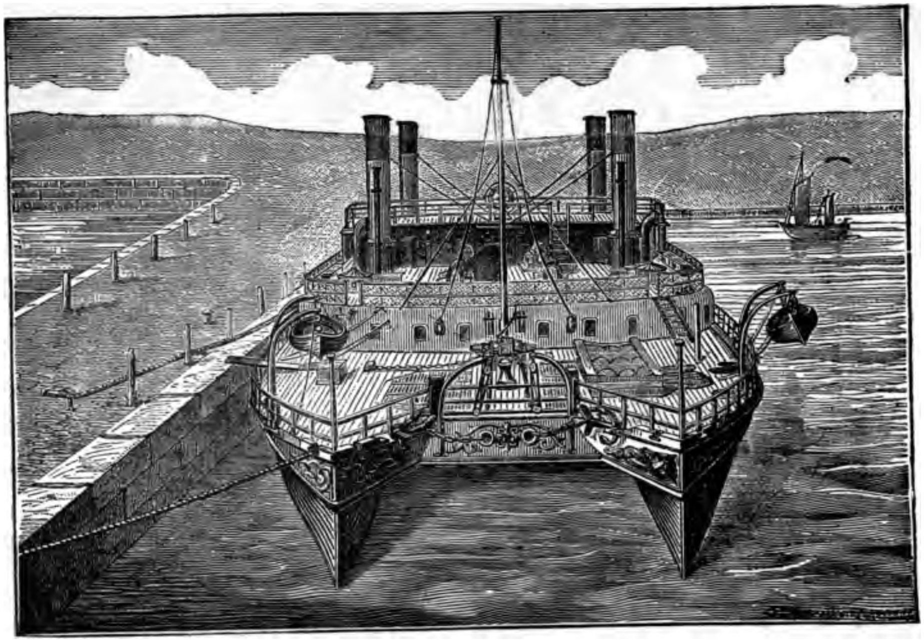
Ocean steamers on this model are designed to be from 400 to 500 feet long, to have no masts or houses or other constructions on deck except the pilot-house, ventilators, and smoke-stack, and to carry passengers on the spar-deck only. There is a railed space on deck where passengers may promenade in fine weather, but when there is any kind of a sea on they are expected to stay below. The interior is to be constantly ventilated by steam fans. A speed of 28 to 30 miles an hour is claimed for the ocean steamer constructed on this system, and as a precaution against accidents each vessel is to be provided with a double set of engines.

Captain Lundborg has designed and patented a twin screw steamship on a principle for which he claims greatly superior speed. His idea is to divide the water horizontally instead of vertically, and, to attain this division, the hull is made narrower at the water-line than it is below. A vertical section of his ship suggests a vertical section through a common hour-glass, flattened at the ends. The bottom of the vessel is flat and wider in proportion than the bottom of the ordinary steamer; for a steamer 450 feet long he proposes two propellers, 16 feet diameter and 28 feet pitch, moved by four compound engines—two on each shaft—making 90 revolutions a minute. Captain

Lundborg is confident that such a steamer can make 22 or 23 miles an hour, carrying 600 first-class passengers, 1,000 second- and third-class, 3,000 tons of cargo, and 2,700 tons of coal, on a draft of 23 feet.

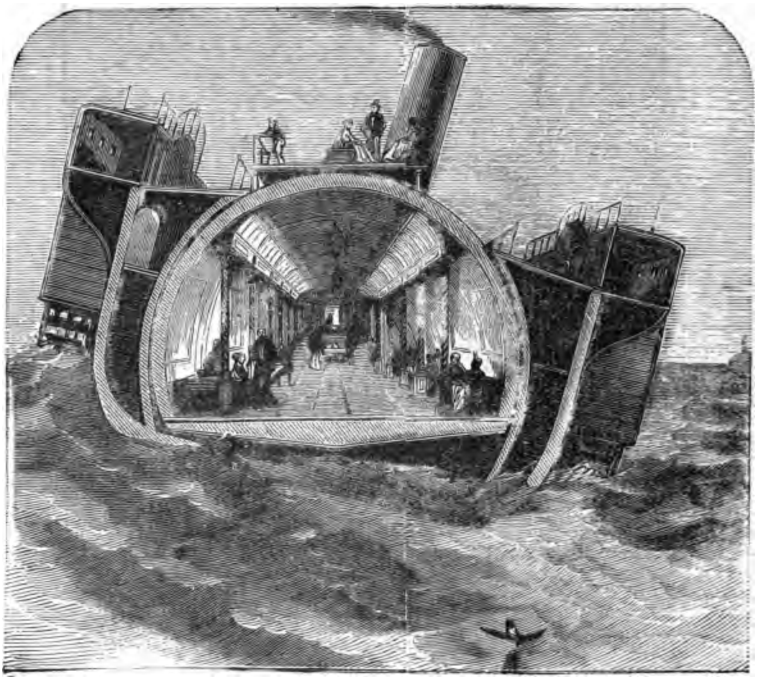
To mitigate the horrors of sea-sickness in the transit of the channel between England and France, several devices have been brought forward. The most successful have been the double-hull steamers, Castalia and Calais-Douvres, the former being the first one tried. She is 290 feet long, and may be briefly described as the two halves of a hull split longitudinally and held firmly apart a distance of 26 feet. The paddle-wheels work in the space between the hulls, and all the space not occupied by the paddle-boxes and engines is floored over, so that we have a deck 60 feet wide. The Calais-Douvres is on the general plan of the Castalia, but larger, and with some improvements. Both vessels were successful in reducing sea-sickness to a minimum, but their speed was not equal to that of the ordinary channel boats.

Another novel craft for the channel transit was the Bessemer, the production of the inventor of that name, and provided with a swinging saloon, something on the plan of the Huston self-levelling berth. She was 350 feet long at the water-line, had four paddle-wheels—a pair at each end—and her engines were calculated to be capable of driving her from eighteen to twenty miles an hour. In the



Castalia—the Twin Steamer.

centre of this craft was a swinging saloon, 70 feet long, 35 feet wide, and 20 feet high. It hung on four bearings, one at each end and one at each side, in the centre. The motion of the saloon was controlled by machinery, specially invented by Mr.



Oscillating Cabin, Steamer Bessemer.

Bessemer, and it was intended to keep the saloon on a level, no matter what might be the movements of the rest of the ship. But it was found in practice that the saloon did not answer quickly enough to the machinery, and the motion, though reduced, was painfully perceptible to those with easily disturbed stomachs.

A novel steamboat, which may be described as "nearly all wheel," has been built by Emil Adam, of Prague, Austria, and is said to have developed astonishing speed. The hull is made of two hollow cylinders of thin metal, tapering to the ends, and having the general shape of double-pointed cigars. On the outer surface of each cylinder is a screw thread formed of metal plates riveted to the cylinder; the inclination of the thread is about forty-five degrees to the axis of the cylinder, and the rotation of the cylinder by a steam-engine on the hull above causes the thread of the screw to advance in water as an ordinary screw advances in a nut.

The deck, where engines, coal, stores, passengers, and crew are placed, is supported upon uprights, extending from the ends of the cylinders, and also from breaks or recesses at different points along their length. At least two cylinders are necessary, but the number may be increased to three or more. It is intended that only the cylinders and the rudder shall be submerged, so that the resistance will be very slight.

It is claimed that the fastest steam vessel afloat in America, if not in the whole world, is the yacht Stiletto, launched in April, 1884. On the 10th of the following June she attracted attention by beating the famous river boat Mary Powell. In a race of thirty miles the Stiletto came out two miles ahead, making the entire distance in one hour and fifteen minutes. The owners of the Powell claim that their boat was not doing its best on that day, and a similar claim is made for the Stiletto by her owners.

The Stiletto was built by the Herreshoff Manufacturing Company, of Bristol, of which John B. Herreshoff is president, and N. G. Herreshoff superintendent and designer. John B. Herreshoff says that the hull of the Stiletto is the product of a series of experiments made with models in the same manner as was followed by Froude, the English shipbuilder, and of the improvements suggested by tests of the numerous steamers previously built by the Herreshoff Company. Her length over all is 94 feet; beam, 11 feet; depth of hold in the centre, 7¾ feet. Below the water line both ends of the craft are very nearly alike, being modelled so as to present the smallest possible surface exposed to the water with a given flotation, as in the attainment of very high speed "skin" or water surface friction is the factor of major resistance. The lines of the bows are very nearly straight, and the bottom is made in round sections.

Power is furnished by a compound condensing engine of 12 inch stroke and cylinders 12 and 21 inches in diameter; the engine is supplied by a sectional water-tube boiler in which steam can be got up quickly, and which is calculated at 450-horse power. Although this boiler is similar in principle and operation to those of the regular Herreshoff type, it varies greatly in construction, the tubes being arranged horizontally in sets immediately over the fire—each set being at right angles to those just above it. Exhaust steam is led to a surface condenser. An ordinary pump takes the water from the condenser, forces it into the upper set of boiler tubes, through the boiler to a separator located in front of the boiler, and to which the steam pipe is connected. The boiler will work safely with 160 pounds of steam, but in the race with the Mary Powell it was only found necessary to use from 120 to 125 pounds. The fire box is 6¼ feet square.

The screw is four-bladed, 4 feet in diameter, and 6½ feet pitch. At the stern the boat draws 4½ feet and at the bow 3 feet.

The engine is designed to produce the greatest amount of power with the least possible vibration. It is an annular valve inverted compound engine. It has two cylinders, one of 12 inches, the other of 21 inches diameter, with 12 inches stroke of piston. With the maximum steam pressure of 150 pounds it will make 450 revolutions per minute. The essential feature of the engine is in the construction of the cylinder, which consists of one cylinder within the other, with an annular space between in which the valve works. The steam ports, or openings through which the steam enters the inner cylinder, are ranged all around it at the top and bottom, so that the steam pressure is exerted on the piston-head from all sides at once, and not, as in the engines in use now, from only one side.

The builder of the Stiletto claims that his boat is capable of running twenty-seven miles an hour. He also claims that an ocean steamer of large size, constructed on the same principles, would have much greater speed than the present "greyhounds of the Atlantic," and an equal, if not greater, carrying capacity.

The question of using petroleum for fuel in place of coal has been mooted for several years, and experiments have been made with it on a small scale. It is in use in steam launches and small boats for inland navigation, but has not been hazarded upon any of the transatlantic or other large ships. The United States Government made elaborate experiments with petroleum upon the steamer Palos (350 tons) covering a period of several months. The conclusion was reached that convenience, health, comfort, and safety were against the use of petroleum as fuel for steam vessels, and the only advantage shown was a not very important reduction in the bulk and weight of the fuel carried. Until popular prejudice can be changed, it is not likely that the passenger traffic on a steamer using petroleum for fuel would be inordinately large.

In recent years petroleum has been exclusively used as fuel for steamers on the Caspian Sea and for steamboats on the Volga. It has taken the place of coal and wood on the trans-Caspian and trans-Caucasian railways, and also on the other railways of the Russian empire. Coal and wood are scarce and dear in Southern Russia, while the petroleum of the Baku oil fields is very cheap; consequently, the advantages of liquid fuel in that region are more apparent than they would be in the United States.

One writer on this subject says that with crude oil at 75 cents a barrel and coal at $3 a ton, their steam-producing values would be identical. A pound of petroleum will evaporate two thirds more water than a pound of anthracite. If the oil is carried in tanks and coal in bunkers, there would be a reduction of 39 per cent. in the space required for stowage of fuel.

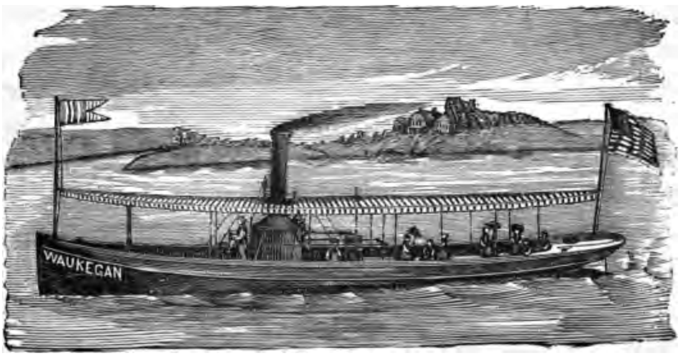
The same writer illustrates the advantages of petroleum by referring to the Etruria, the latest of the Cunarders. "It burns," he says, "on a passage of six days and a half 2,275 tons of coal, but to be prepared for delays, it carries 3,000, leaving only 400 tons for freight. If 39 per cent. of space could be economized on such a vessel as this, it would give space for 1,170 tons more cargo of the same gravity as coal."

The oil-burning steamers on the Caspian Sea have an apparatus which is managed by one attendant. The same steam-producing ability with coal and fuel would require ten firemen, so that for the watches on and off two men take the place of twenty. A small stream of oil falls upon a jet of steam — the oil and steam combined produce a combustible spray of intense heating power.

On nearly all large steamships the steering is now performed by steam power in place of the old hand method. A single wheel about two feet in diameter and moved by a touch of the finger takes the place of the old-fashioned apparatus, where ofttimes in a gale as many as four, and even eight, men exerted all their strength to keep the ship to her course. A movement of the little wheel in either direction sets the machinery in action; the rudder is turned to right or left at the will of the helmsman, and more quickly than by the old method.

Progress never ceases. A recent invention provides for steering a ship by means of electricity and compressed air, and the apparatus is so arranged that it is operated by the mariner's compass. Two platinum points are fixed in the bottom of the compass card in such a way that a movement of the card beyond a certain distance causes the points to dip in little cups of mercury and complete the electric circuit. The closing of the circuit actuates the machinery and the rudder is turned accordingly. The compass can be set for any desired direction and the helmsman may go to sleep at his post without any fear that the ship will leave her course.

Whether this new system will meet with general favor is extremely doubtful. Sea-captains are proverbial for an unwillingness to allow their men to grow rusty in the joints, and they look with disfavor upon all appliances designed to remove responsibility from their subordinates. Steering by means of the compass will not be likely to do away with the present gear operated by steam, or even with the old-fashioned wheel, where the men stand up to their work.



Steam Pleasure-Boat.

CHAPTER XXII.

First Steam Vessels of War in England, France and other countries—Revolution in Naval Architecture—The First Iron-Clad—Battle Between Monitor and Merrimac—Turreted War-Ships—Present Thickness of Plating on Armored Ships—Strength of the Navies of the World—Torpedoes and Torpedo Boats—Different Systems in use—The Battle on the Min River—the Nordenfeldt, Goubet, Tuck, and other systems—Present Work of the Great Naval Powers.

WE have seen elsewhere how Robert Fulton designed and built the first war steamer the world ever saw, and have also read of the experiments in the British navy with steam as a means of propulsion. As we look back to 1820, when the Comet, Lightning, and Meteor gun-boats were ordered for the British navy, in spite of the opposition of the surveyors in office, it seems strange that it was not readily foreseen that steam would shortly become the only motive power for ships of war. Yet so slow were the British naval authorities to act that in 1831, according to a writer in the *United Service Journal*, there was not one steam man-of-war in the Royal navy, and the construction of engines had not even commenced in the Royal dock-yards.

In 1828 the French admiralty ordered the establishment of a steam dock-yard, and in 1830 France had nine armed steamships afloat and nine more under construction. In 1822–25 the United States navy contained the steam galliot Sea-Gull, which was used for the suppression of piracy in the West Indies ; afterwards she was employed at Philadelphia as a receiving ship, and was sold out of the service in 1840.

The Fulton Second was launched in 1837, and was the second steam war vessel built by the United States ; She may be regarded as the pioneer of our present steam navy, as she was intended for sea cruising, while Fulton the First was a floating battery for harbor defence rather than for aggression. The Fulton Second was propelled by paddle-wheels, and made, in smooth water, nearly fifteen miles an hour. Afterwards she was lengthened and equipped with new boilers and engines, and sent to cruise in Southern waters under the name of Fulton Third. She was laid up in ordinary at Pensacola at the outbreak of the Civil War, and was destroyed by the rebels.

Russia, Germany, Italy, Austria, and other nations having or seeking a place among maritime powers, were not slow to adopt steam as a motive force. But it is curious to observe that all were reluctant to abandon the old form of sailing craft, and none more so than England, whose naval triumphs had been won by Drake, Rodney, Nelson, and a host of other famous captains, before the present uses of steam were thought of.

To follow the history of naval architecture with the great maritime nations would occupy far more space than we have at our disposal, and also run the risk of being tedious to the general reader. Volumes have been filled with the story of the development of the ship of war—from the great three- and four-deck frigates of the last century, often with an armament of more than a hundred guns, and with sides high above the water, justifying the name of "wooden walls," to the modern turret-ship, barely visible above the surface and having an armament of only a very few guns.

It is safe to say that the chief, if not the only, cause of this development has been the introduction of steam as a marine motive power. Nelson's flag-ship at Trafalgar, the Victory, 100 guns, would be no match for any one of a dozen ships that might be chosen from the British Navy, with powerful engines, ramming prows, steam-manœuvred turrets, and the other appliances that steam has made possible, but without a twentieth of the number of guns carried by the Victory. The same may be said of the French, Austrian, German, Russian, Italian, and other navies; possibly we may include our own in the list, though we do so with much hesitation. Naval architecture in the United States has made very little progress for more than a decade, nor is it likely to show much advance until public attention is aroused to a knowledge of our defenceless condition.

Down nearly to 1860 all nations had relied upon wooden ships for their navies ; a few iron ships had been constructed, but the models had not materially changed from those of half a century earlier. There was a tendency to reduce the number of decks and it was evident that the great four-deckers of former times were to be set aside for ships more easy of manœuvring. The paddle had made way for the screw as a means of propulsion. With paddle engines a portion of the machinery was exposed to an enemy's shot, while with a screw steamer every thing was below the water level ; besides, the screw left the whole broadside free for fighting or other purposes, which before was considerably encroached upon by the paddle-boxes. The general shape of the ship was the same as of old and for cruising purposes most war ships made use of their sails far more than of steam.

The idea of protecting the sides of vessels with armor of some kind is very old, dating almost as far back as the invention of gunpowder. Indeed, some of the Roman galleys and other vessels before gunpowder was thought of had their sides protected with leather, cordage, wooden beams, heavy planking, or with plates of iron, brass, or other metals. Floating batteries with armored sides were used in the siege of Gibraltar in 1782, and other batteries were constructed at different epochs. We have given elsewhere an account of the Stevens' battery, which seems to have been the first vessel of the armored class after the one planned by Fulton. The English Government made several experiments with armor plating, but the conclusions were unfavorable to its adoption.

To France belongs the credit of the first iron-plated steam frigate of the first class. In the Crimean War she constructed and used four small gunboats with armor plating; in March, 1858, work was begun on La Gloire, a sea-going frigate carrying thirty-six guns, and protected amidships with plates of iron four and a half inches thick, with a backing of two feet of solid timber. La Gloire was the precursor of the iron-clad fleet of France, and virtually of the iron-clad fleets of all nations of the globe. Shortly after she was begun the French laid the keels of the Normandie and the Invincible on the same plans. England could not afford to lie idle under these circumstances; her naval authorities ordered the building of the Warrior and shortly afterwards of the Black Prince, Defence, and Queen.

In 1860 Austria began the construction of two iron-clad steam frigates, and at the same time Italy began work on two iron-clad steam corvettes. Russia followed the example of the other powers, and gave orders for iron-plated frigates, and the Naval Board of the United States had the subject under consideration at the outbreak of the Civil War.

In 1861 the seizure of the lower Mississippi by the rebels rendered the construction of armored ships a necessity, and it was undertaken, not by the Navy, but by the War Department. The first of the iron-clad gunboats were designed and built by James B. Eads, an engineer of St. Louis, and in a very short time he turned out the St. Louis, Carondelet, Cairo, Louisville, Mound City, Pittsburgh, Cincinnati, and Benton. These boats were plated with iron 2½ inches thick on a backing of 4 inches of wood placed at an angle of 45 degrees in order to glance off horizontal shot; they were not impenetrable to heavy guns, but were safe against field-batteries and smaller cannon, and did excellent service in the work for which they were intended. Several other boats of the same kind were built during the course of the war.

In the same year the rebels raised the screw steamer Merrimac at Norfolk Navy Yard, where it had been sunk when the place was abandoned by the Government. They cut down her sides, plated her with railway iron at an angle of 45 degrees over a backing of wood, armed her with ten 9- and 10-inch guns, and on the 8th of March, 1862, sent her against the Government fleet in Hampton Roads. She sunk the frigate Cumberland by ramming, destroyed the Congress with her battery, and then retired for the day. Next morning she returned to the scene of operations and attacked the frigate Minnesota, but was herself attacked by the Monitor, an iron boat with a revolving turret, armed with two 11-inch

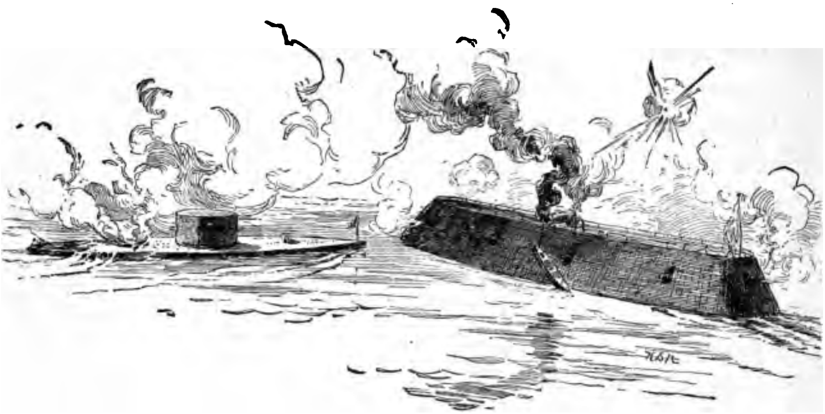
Dahlgren guns. The fight between the Monitor and the Merrimac was a spirited one, and resulted in the retirement of the Merrimac badly injured.

The battle was in some respects one of the most important that ever occurred in maritime warfare. It revolutionized the course of naval construction all over the globe, and compelled the adoption of systems of which few had dreamed until that day. The Monitor is too well known to need a detailed description. Suffice it to say she was 173 feet long over all, 41 feet 6 inches wide, and 12 feet deep. She was the greatest possible contrast to the old-fashioned ship of the four-decker class, her freeboard being so low that she was hardly visible above water at a little distance. Her revolving turret was 20 feet in diameter and 9 feet high, made of inch plates of wrought-iron riveted together until they reached a thickness of 8 inches.

The Monitor was built in New York in one hundred days, at a cost of $275,000. Her designer was John Ericsson, whose name has been repeatedly mentioned in this volume. The turret which formed an important feature of this new style of gunboat, was the invention of Theodore R. Timby, with additions and improvements by Ericsson.

England was more active than any other nation in benefiting by the lesson of Hampton Roads. Her dockyards swarmed with workmen busy with the construction of iron-clads on the turret or other system, and wherever one of the old wooden ships was found sufficiently sound to warrant her preservation, she was cut down and armored as the Merrimac had been. France, Austria, and other maritime powers showed commendable zeal in following the example of England, and in less than a decade the fleets of the world were almost completely changed.

The United States built a considerable number of



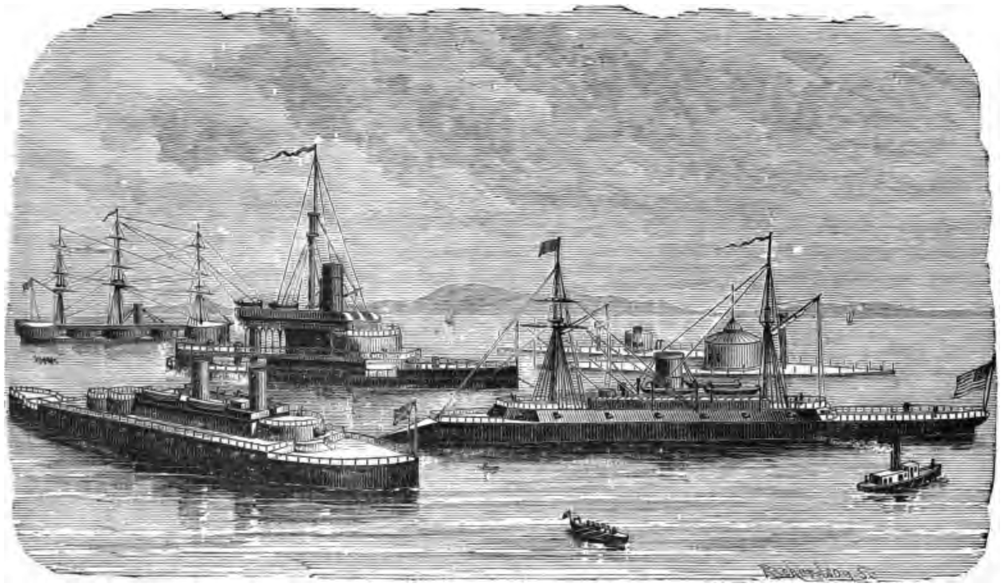
The Monitor attacking the Merrimac.

iron-clads, some upon the principle of the Monitor, with a single turret, others with two turrets, and a few with iron-plated sides and bulwarks but without the Monitor system. Many of these boats were severely tested during the war; some were lost, but the majority survived through many perils and were afloat, and practically uninjured, in 1865 when peace was declared.

The original Monitor was lost in a gale off Cape

Hatteras ; the Merrimac was blown up by the rebels when they abandoned Norfolk. The Monitors were never intended for cruising purposes, but they moved safely along the coast during the Civil War. In 1865 one of them, the Miantonomah, visited Europe, going up the Baltic to Cronstadt, making a cruise in the Mediterranean, and returning home by the West Indies. Another of these vessels, the Monadnock, went to California via the Straits of Magellan without accident ; two others, the Catawba and Oneonta, were sold to the Peruvian Government and went to Callao where their names were changed to Manco Capac and Atahuallpa.

At the present time all the fighting ships of the world, with the exception of coasting and revenue steamers, armed despatch boats, light gunboats, and similar craft, are protected with armor in one sort or another. In all the maritime nations there has been a friendly contest between the naval architects and the ordnance board, the one attempting to build an impenetrable ship and the other to devise a gun that shall penetrate whatever the other builds. Thus far the guns have the best of the contest, as no targets have been made that can resist the smashing force of the steel projectiles of a thousand pounds and more thrown from the monster cannon which the English ordnance department or private English constructors have turned out. In range, weight, or projectiles, rapidity of firing, and in nearly every other



Modern Iron-Clads.

quality, the rifled cannon of to-day are immensely in advance of those of the time of our war.*

Such of the wooden sailing vessels as still exist in the navies of the world are used for receiving and training ships at the navy yards, and if they go to sea at all it is for school purposes or for the transportation of stores. The strength of the navies of the world is set down as follows in the latest obtainable returns :

* "The period since the close of our Civil War has been prolific in great advances in the means and methods of attack. The iron plating of ships-of-war has been increased from four inches to twenty-five inches on the English ship *Inflexible*, and when a practicable limit as to the thickness of iron plates seemed reached, compound armor and all-steel plates were introduced. Recent British ships carry eighteen inches of compound armor, and the *Admiral Baudin* and *Formidable* of the French navy are protected by solid steel plates twenty-one and seven-eighths inches in thickness.

"Heavy ordnance has increased in weight and power to a like extent. Whereas in 1862 our 200-pounder Parrot rifle was one of the most effective weapons extant, we have, in 1872, the English $17\frac{3}{4}$-inch, 100-ton gun, firing a projectile weighing one ton with a powder charge of 550 pounds, and in 1884, the $16\frac{1}{4}$-inch, 110-ton Armstrong, which fires an 1,800-pound projectile, with the enormous charge of 900 pounds of powder, giving a muzzle energy of 61,200 foot-tons, and a penetration of over thirty inches of wrought iron at 1,000 yards. The recent Krupp $15\frac{3}{4}$-inch steel gun weighs 119 tons, and penetrates 29.2 inches of iron at 1,000 yards ; and the projected French gun is to weigh 124 tons, with a calibre of 18.11 inches, and to fire a projectile weighing 2,645 pounds, with a powder charge of 575 pounds.

"In August, 1883, Sir Joseph Whitworth, in testing a 20-ton steel gun intended for the Brazilian iron-clad, *Riachuelo*, fired a 403-lb. steel shell through eighteen inches of wrought iron, thirty-seven inches of well-packed wet sand, one and one-eighth inches of steel, various balks of timber, and about sixteen feet more of sand. *The projectile was recovered practically uninjured.*" — "Our Seacoast Defences," by Lieut. EUGENE GRIFFIN, U.S.A.

Countries.	No. of Vessels.	No. of Men.	Countries.	No. of Vessels.	No. of Men.
Argentine Republic.	33	991	Japan.	31	5,551
Austria-Hungary.	68	7,222	Mexico.	8	
Belgium.	10	172	Netherlands.	165	3,436
Brazil.	48	4,984	Norway.	46	915
Canada (Dominion).	7		Peru.		
Chili.	10	2,225	Portugal.	39	3,200
China.	56		Roumania.	10	530
Denmark.	44	1,122	Russia.	373	28,975
Egypt.	13		Spain.	124	21,678
France.	302	39,365	Sweden.	123	7,723
Germany.	91	15,200	Turkey.	49	40,392
Great Britain & Ireland.	246	57,250	United States.	93	12,204
Greece.	16	2,637	Venezuela.	4	200
Italy.	72	15,140			

This gives a total of 2,191 vessels, of which not less than three fourths are propelled by steam. This does not include a great number of steam launches, tenders, small despatch-boats, and the like, nor the swarms of torpedo boats which the maritime nations are rapidly accumulating. Of these additional naval craft there are probably not less than three thousand and it is safe to say that the navies of the world contain fully five thousand vessels of different name and kind whose propelling power is steam.

There is an active rivalry among the maritime nations in the effort to obtain naval supremacy ; the skill of inventors and architects is taxed to the utmost capacity, and enormous amounts of money have been expended upon experiments or upon the construction of ships on novel principles. The torpedo, the submarine boat, and possibly the use of dynamite in projectiles, promise to make as great a revolution in the system of maritime warfare as did the application of steam to the propulsion of naval vessels.

Before going further, we will examine some of the modern appliances. The torpedo and the submarine boat have been mentioned in a previous chapter, as they were the study of the subject of this biography, and derived several of their important features from his inventive skill. Dynamite guns are new to us; dynamite was unknown till more than half a century after Fulton's death, and it is only since this compilation was begun that experiments to use it in projectiles have been successful. If this terrible explosive can be safely handled and used for the charging of shells, the modern iron-clad ship will be as penetrable as the old wooden wall of a hundred years ago. Naval warfare will come to a speedy end through the destructiveness that will be in the hands of all the combatants.

Of the offensive torpedo of to-day there are many varieties: the Whitehead, Pole, Ley, Harvey, and Nordenfeldt systems are the best known, each of them bearing the name of its inventor. Briefly described, they are self-propelling boats, carrying an explosive which is designed to destroy the ship of an enemy ; some are propelled by electricity, others by compressed air, and others are carried at the ends of spars, projecting from the bow of a steam-launch sufficiently far to leave the latter in a place of safety.

Only a few of the modern torpedoes have been tried in actual warfare. In a previous chapter, mention was made of their use in the war between Russia and Turkey, and the comparatively inconsequential results. Up to the time of writing these pages, the most notable instance of the use of torpedoes in naval warfare is in the operations of the French in China in 1884. The result is thus described by an officer of the United States navy who was on the Min River at the time of the destruction of the Chinese fleet :

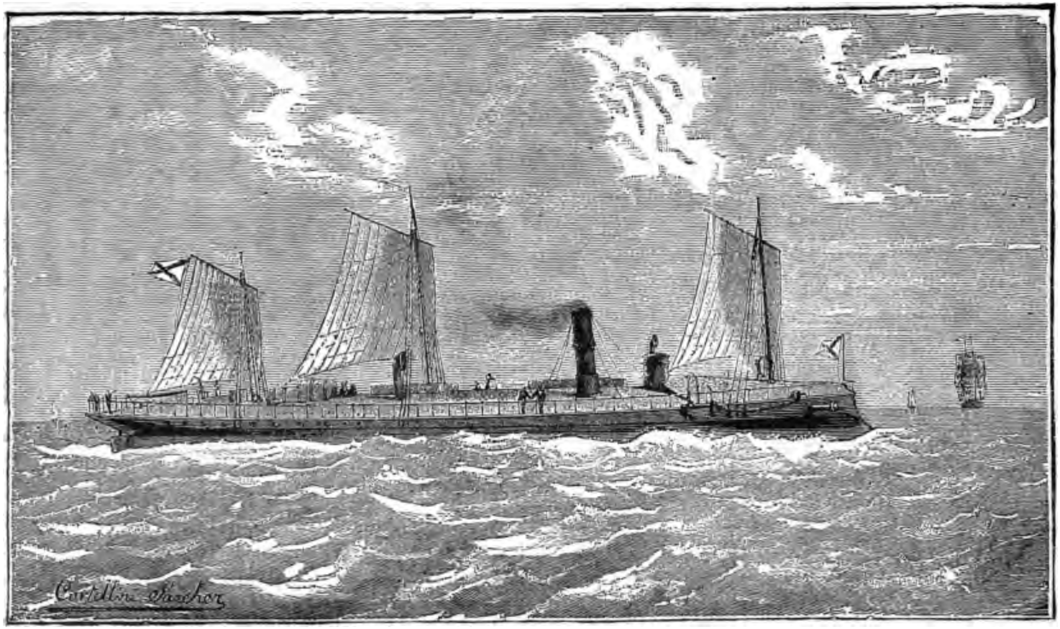
"Four minutes from the commencement of the action a heavy explosion told the successful work of the torpedo-boat detailed to destroy the Yung Woo. In this short time, and before the Yung Woo was fairly in action, and had brought her guns to bear, the torpedo had done its deadly work, and had destroyed this fine vessel. The officers in charge of the torpedo boat had successfully placed a torpedo under her counter while she was in the act of turning. It nearly blew her out of water, and the vessel soon sank, on fire afore and aft, a total wreck. Many of her officers and crew perished. The torpedo boat dropped down the river, out of action, her commander and one of her crew having been wounded, probably by one of the French machine guns. Referring to the machine guns, which the French seem to have had in abundance, the writer remarks that the greatest destruction was occasioned by them. They rained their explosive shells upon the decks, cutting down the crews at their guns, so that they could hardly reload them. Their fire demoralized men and officers, and drove them to seek shelter and escape by jumping overboard. The decks of the vessels, as they drifted down the river, were covered with dead and wounded. To these guns may also be ascribed the rapidity and thoroughness with which the vessels were set on fire. The importance of this class of armament was clearly demonstrated in this action, and the conditions for their use were the most favorable. No modern man-of-war will be efficient without them. Her crew would be at the mercy of an opponent armed with them. The French torpedo boats were of steel, about fifty feet in length, of high speed, armed with spar torpedoes.

"In Admiral Courbet's operations, two torpedo launches from the flagship Bayard were despatched up the Yang-tse-Kiang to destroy two Chinese men-of-war, the frigate Yu-Yuen and the corvette Tcheng-King, anchored in the channel and covered by fire from the shore. The attack was made in the night, but the boats were discovered before getting up, and were received by a warm fire from the frigate, which was supported from the shore. The boats put on full speed. Commander Gourdon's boat struck first, right astern. The torpedo exploded, but the boat could not get away as her spar was caught, and she had to unscrew her fittings to let go. In this critical position, a man was killed by a shot from shore. The boat was backing off when Lieutenant Duboc's boat came up at full speed, struck the frigate on the starboard quarter, and exploded her torpedo. The engine had been reversed before the collision, and she got clear at once, and the two boats made off together under the fire of the Chinese small arms and machine guns. By the light of early dawn it was seen that the frigate sank, remaining upright, halfway to her tops, the corvette being inclined and sunk to her rail. It seemed probable to the French commander that the corvette was sunk by the fire of the shore batteries and frigate against the boats. The frigate was a fine vessel, of 3,400 tons, built at Shanghai, on the plans of American constructors, about twelve years ago. She was armed with twenty-three breech-loading guns, twenty of which were in broadside and three on the forecastle and poop. She had also some Nordenfeldts. The corvette had seven guns."

The machine guns referred to by the above writer were probably the French mitrailleuse and the guns of the Hotchkiss system, which has been adopted by the French and also by the naval authorities of other nations. There are several sizes of this gun or cannon—the smallest throwing a projectile the size of an ordinary rifle ball, while the largest throws one weighing four pounds. The gun is mounted on a pivot, either on a carriage or on the rail of a ship, and can be aimed from the shoulder like an ordinary musket. The smaller size has a range of five hundred yards and more, while it is claimed that the largest sized gun can deliver its projectiles at the rate of twenty a minute a distance of fully one mile.

Other machine guns are the Gatling, Berdan, Maxim, Gardner, and Nordenfeldt—the last being largely used in the English navy (together with the Hotchkiss), and the first having a favorable name all over the world. In range, rapidity of fire, and general effectiveness, they vary greatly; some of them discharging heavy projectiles at a slow rate, and others throwing smaller ones more rapidly. The range varies from three hundred yards upwards. They discharge from twenty to five or six hundred projectiles in a minute. The Gatling fires 1,200 a minute, and the weight of the missile is adapted to the size of the weapon, each system having a series of sizes. At close quarters in a naval encounter they are terribly effective, but, happily for the human race, have been tried only on rare occasions.

Of the offensive torpedoes, the Whitehead is probably the best known and more generally adopted than any other. Several of the maritime nations have adopted it, to the exclusion of other systems, while some have given all the prominent systems a place. The torpedoes are carried upon ships of war to be launched from ports or openings specially prepared for them, and every fleet has a liberal equipment of light, swift-running boats, carrying torpedoes for offence, and armed with machine guns and smaller weapons for defence. These torpedo boats are capable of steaming 18 or 20 miles an hour, and it is claimed recently that an English torpedo boat has exceeded 22 miles. The intention is for the boat to come within a few hundred yards of an enemy's ship, and then launch a torpedo in the latter's



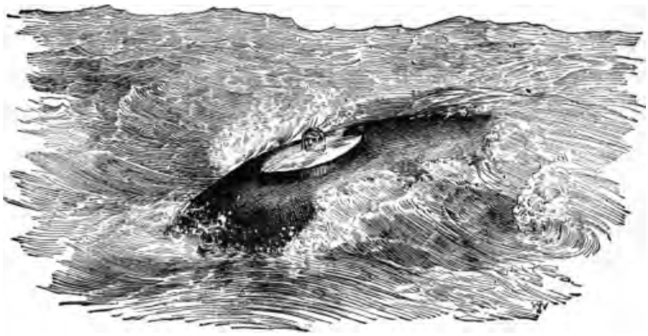
New Russian Torpedo Boat.

direction. By means of its own propulsive power, the torpedo then goes to its mark—provided, always, the mark remains where it should.

Many naval men claim that the torpedo as an offensive weapon has been greatly overrated, and believe that its effectiveness is really very slight. Of course it will be impossible to demonstrate who is right and who wrong in the controversy, until a great naval contest shall occur. It is therefore to be hoped that the settlement of the controversy will be indefinitely postponed.

Numerous inventors have busied themselves over designs of submarine boats, but few have brought out any thing practical and useful. The most successful craft of this kind thus far are those of Nordenfeldt and Goubet, but as neither has been tried in real warfare, the success is theoretical rather than practical. The boats are ingeniously contrived, and deserve more than a passing notice.

Mr. Nordenfeldt is the inventor of the gun that bears his name. His first submarine boat was built at Stockholm in 1883, and is intended to be completely submerged at the will of her commander. According to the published description the boat is cigar-shaped, with a coffin-like projection on the top amidships, formed by vertical combings supporting a glass dome, or conning tower, one foot high, which enables the commander to see his way. The dome, with its iron protecting cover, stands on a horizontal lid, which can be swung aside to allow the crew of three men to get in or out without difficulty. The length of the hull is 64 feet, and the central diameter 9 feet. It is built of Swedish mild steel plates $\frac{5}{8}$ inch thick at the centre, tapered to $\frac{3}{8}$ inch at the ends, supported on angle-iron framing, 3 inches by 3 inches by $\frac{3}{8}$ inch. The arrangements for sinking the boat are of a special nature, for which the inventor claims important advantages. Practically, such a boat can be sunk in three ways—singly or



Nordenfeldt Submarine Boat.

taken in combination. It may be forced down by power applied from within, weighted down by taking in sea water sufficient to destroy the buoyancy, or it may be steered down by the application of its ordinary motive power, modified by a horizontal rudder. Mr. Nordenfeldt has adopted the former arrangement, placing sponsons on each side of the boat amidships, in which are wells for the vertical propellers capable of working the boat up or down. In order to prepare for action, enough sea water is taken in to reduce the buoyancy to one hundredweight, which suffices to keep the conning tower well above the surface. In order to sink the boat further, the vertical propellers are set in motion, and, by their action, it is held at the required depth. Thus, to come to the surface again, it is merely necessary to stop the vertical propellers, in which case the reserve of buoyancy at once comes into play. This principle is rightly regarded as important, even if not essential, in a safe submarine boat. A break-down in the engines does not entail danger, since the reserve of buoyancy is never lost for a moment. As a still further safeguard, however, Mr. Nordenfeldt has provided an automatic check on the downward motion. A lever, with a weight which can be adjusted so as to counterbalance any desired head of water, is connected with a throttle valve supplying steam to the engines working the vertical propellers. Thus directly the desired depth is exceeded, the increased head of outside water overcomes the weight, and the vertical propellers are stopped.

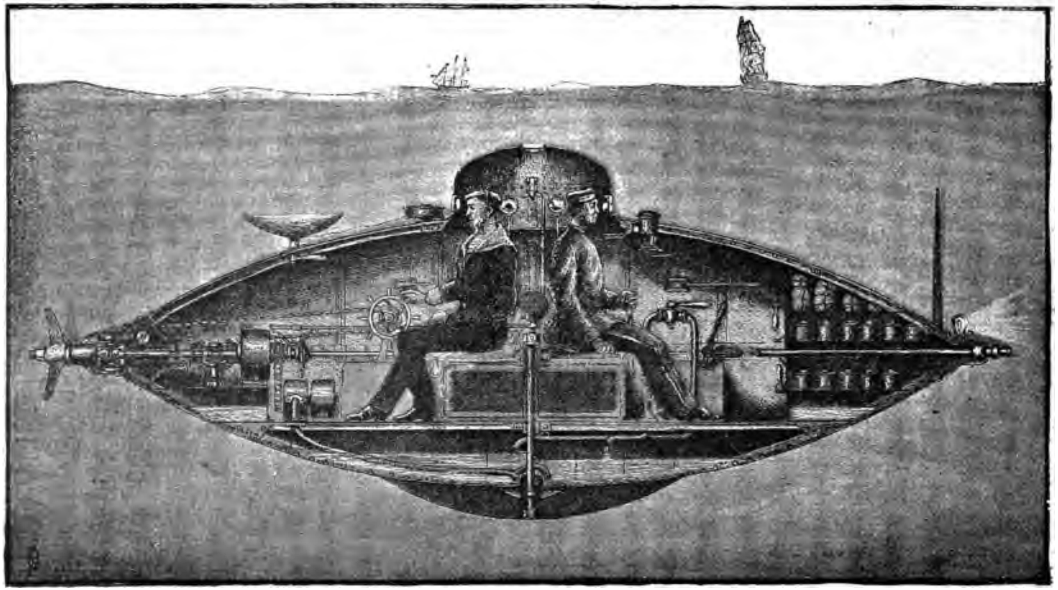
The motive power is steam alone, generated in a boiler of the ordinary marine type with a forced draught. So long as the boat runs on the surface, this boiler can be stoked and a constant head of steam maintained. The smoke is driven out through two channels which pass partly around the hull and point aft. For submarine work, no stoking is, of course, possible, and the fire-box has to be sealed. It is therefore necessary to store the requisite power beforehand, and this is done by heating the water in two tanks placed fore and aft and connected by circulating tubes with the boiler, till a pressure of about 150 pounds per square inch is attained. With about this initial pressure, it is stated that the boat has been driven for 16 miles at a speed of three knots. The greatest surface speed attained is a little over

Interior of Nordenfeldt's Boat.

eight knots, and the boat has been run for 150 miles without recoaling. There are three sets of engines, one of which drives the propeller, an ordinary four-bladed screw, 5 feet in diameter, with a pitch of 7 feet 6 inches. The other engines drive the blower and the horizontal propellers respectively.

One of the principal difficulties of submarine navigation is to preserve an even keel when under water. Should a boat turn downward when in motion below the surface, it might easily strike the bottom, or reach a depth at which it must collapse before its course could be arrested. On the other hand, if the bow took an upward turn under the same circumstances, the boat would rapidly come to the surface, and be exposed to view and to projectiles. It is evidently, therefore, of the utmost importance to provide ample steering power in a vertical direction. In the Nordenfeldt boat two horizontal rudders are placed, one on each side near the bows, and are acted upon by a pendulum inside the hull. This pendulum, coming into play the instant the boat takes a cant in either direction, actuates the horizontal rudders and causes her immediately to return to an even keel. By this means it is claimed that the boat is automatically kept with her axis horizontal, while since the bow rudders are entirely beyond the control of the crew there is no danger of accident due to neglect or loss of nerve. In the event of a breakdown of the above arrangement, it is necessary at once to stop the boat and let her return to the surface. No compressed air is carried, and the crew depend, therefore, for existence on the amount of air sealed up in the hull. With this amount of air only, four men have remained for a period of six hours without any especial inconvenience.

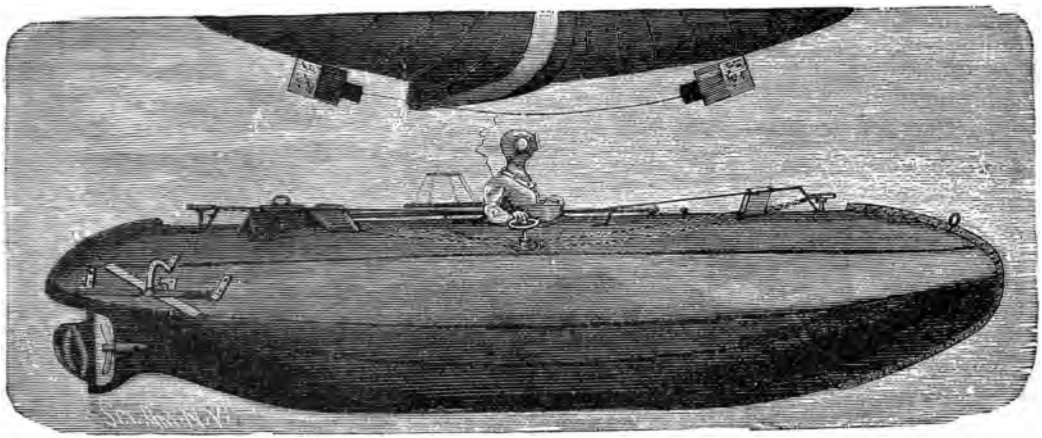
M. Goubet, the inventor of another submarine boat, is a Frenchman ; the Russian Government has ordered three hundred of his boats, and a Paris news-



Goubet's Submarine Boat.   Adopted by the Russian Government.

paper, *L'Illustration*, of November 28, 1885, says that fifty of these have already been finished and delivered. The boat is propelled by electricity, contained in accumulators or secondary batteries; the screw-shaft has a joint, so that the screw can be inclined to right or left while in motion, and thus the course of the boat is directed without the necessity of a rudder. An officer and a sailor compose the crew, and they are seated back to back under the dome, which has to be removed to permit ingress or egress. All around the base of the dome are glass "bull's eyes," for purposes of observation. At starting on an expedition the officer notes the direction of the point he wishes to attain by sighting upon a guide-rod which rises like a flagstaff from the bow and taking its bearings by compass. Then, with the compass strictly beneath his eye, he gives the required instructions to the man at the wheel.

The box on which officer and man are seated is filled with compressed air. The proper buoyancy is maintained by receiving or discharging water by means of a pump, and in case of damage to machinery or other accident the leaden keel can be instantly detached, and the boat will rise rapidly to the surface. The torpedo is carried on the top of the boat near the stern; it is provided with hooks by which it is prevented from slipping from the bottom of an enemy's ship, and it is buoyant, so that it rises when detached by the hand of the sailor who has it within

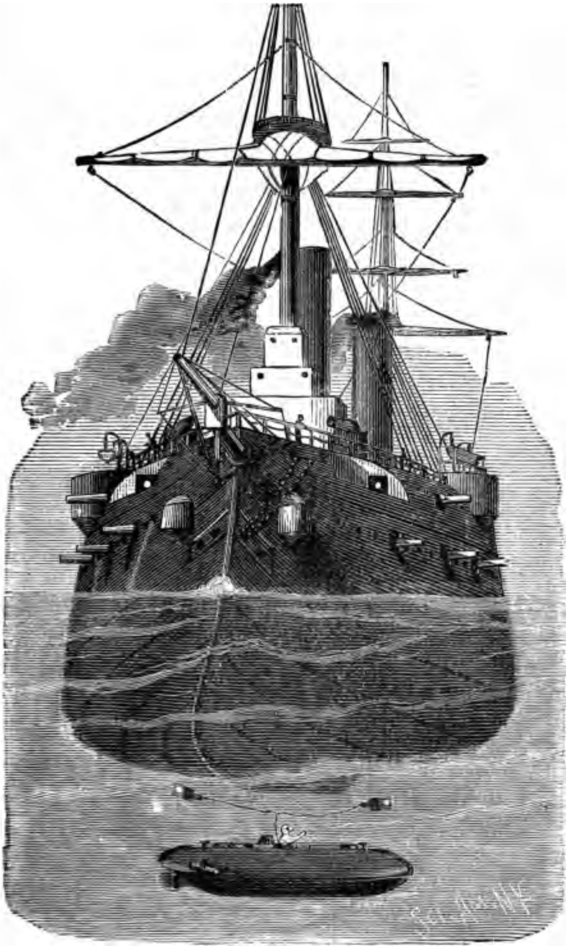


Tuck's Torpedo Directly Beneath the Vessel.

reach. When it is detached the boat moves off, an electric thread a hundred yards in length unwinds, and as the end is reached the torpedo is exploded by means of the spark. The boat is about 20 feet long by three and a half in diameter, exclusive of dome and keel, and therefore much smaller than the Nordenfeldt boat. It has a speed of five knots an hour, and can remain five or six hours under water at a time. The Russian Admiralty has faith in its ability to blow up an enemy's ships at anchor, but does not pretend that it would be of any use in attacking a ship in motion on the sea.

An American inventor, Mr. J. L. Tuck, has designed a submarine boat propelled by electricity or by compressed air at a speed of four to five miles an hour. He claims to be able to place and explode a torpedo beneath a ship at anchor, by means of his boat which can be operated by one man. The mode of working it is as follows:

The boat is about twelve feet long and has the general appearance of a ship's yawl with a deck over it. It is propelled by a screw and steered by a rudder and the propelling and steering apparatus are under the control of the operator, who sits in a sort of well in the centre of the boat with the upper half of his body encased in a suit of submarine armor. Within his reach is the handle of a pump that will admit or eject water in order to sink or raise the boat, and lying on the top of the boat is



Tuck's Torpedo Leaving a Vessel.

the torpedo which is to blow up the ship which has been destined for destruction.

The operator steers his boat so as to bring it beneath the ship. Then he releases the torpedo which is in two sections, connected by a cord and made buoyant so that it will rise when released and lie against the bottom of the ship. Having properly placed the torpedo the operator retires, unwinding an electric wire as he goes. At a safe distance he touches an electric key, and if every thing works as predicted and expected the ship is blown into fragments.

The submarine boat of the future will possess the immersive abilities of the craft just described, together with the power to propel itself not less than twenty miles an hour when wholly submerged. Such boats will be dangerous to ships in motion as they can be launched from the side of the vessel that carries them, and with speed superior to that of the enemy, can overtake and destroy him. Suppose a boat of this kind with a speed of twenty miles an hour is launched against an enemy's ship ten miles away, the latter having a speed of fifteen miles. The chase lasts two hours; the submarine boat rises a few moments at a time to take fresh air and learn the bearings of the pursued, but never remaining long enough above the surface to run any serious risk of being hit by a shot. At the end of the chase the torpedo makes short work of its victim, unless the skill of the inventor provides a netting that shall enclose the ship below as well as at the sides. Nettings are now in use to prevent surface torpedoes reaching the side of a ship, but no netting has been devised to protect it from below.

Colonel Berdan claims to have devised a torpedo for use against a ship protected by nettings. It is in two parts, and as one part strikes the netting, the other drops off and sinks below it, till it tightens a cord by which the two are connected. This cord sets in motion some machinery that carries the torpedo upwards inside the netting and against the side of the ship, where it explodes by a simple device. If this torpedo works according to the inventor's calculations, the crinoline protection for ships will be of no further use.

The same inventor has designed a high-speed torpedo boat, which is thus described:

"The boat is a double-ender, with a shaft running through it, having a screw at each end. One screw will pull and the other push. With these two screws and the powerful engines it is proposed to carry, the boat ought to attain a speed of twenty-four and one half knots an hour, according to verified calculations. Nearly all the space below the water-line will be taken up by engines of 1,200 indicated horse power and coal sufficient for four days' running. This enormous power will be so distributed as not to rack the boat to pieces in its application. The double arrangement of screws will help to this end.

There are, of course, incidental disadvantages in such an arrangement, but it is hoped that the advantages will outweigh them. All the engines and boilers will be below the water-line, so that only a plunging shot can reach them. They will be arranged in two sets, so that if one is disabled by a shot or otherwise, the other will be left to drive the boat at nearly three-quarters speed. The screw shaft is geared to the engine shafts, so as to make three revolutions to one of theirs, and is designed to make 100 turns a minute.

"The four pairs of torpedoes will be arranged two at each end of the boat, and thus both load and power will be evenly distributed over the craft. The dimensions are to be: Length, 220 feet; beam, 20 feet; and depth, 10 feet. A double-track railway extends fore and aft along the deck. On this will run the trucks that carry the torpedoes. These trucks will be furnished with them, will go overboard with them, and will not be recovered. The torpedoes will cost $10,000 a pair. They are to be designed for three speeds—one to run at thirty knots an hour for outside work, one at twenty knots for large rivers, and a third at a still lower speed for cramped places. The highest speed is not desirable in the latter cases, because accuracy is sacrificed in part. The torpedo may run by its mark before it is accurately aimed. An elevated disk carried on the leading torpedo shows where it is, and, by keeping that in line with the desired mark, the steersman is enabled to send the two easily and certainly to their destination. It is as simple as steering a boat. The steersman on the torpedo vessel pulls one or the other of the tiller wires until the disk comes up into line with the mark. The system of two connected torpedoes is to be used against iron-clads—a single torpedo being sent against a hostile torpedo boat or other craft without armor."

Let us see what is being done in the different navies of the world, and, as we do so, we bear in mind that every ship referred to is propelled by the power first successfully applied by Fulton to the Clermont.

Our Board of Officers appointed by the Secretary of the U. S. Navy to consider plans for new cruisers have recommended the construction of two ships of from 3,000 to 5,000 tons, and two gunboats of 1,600 and 1,000 tons respectively. A recent writer on this subject says :

" The latest twin-screw cruisers built in England for the Japanese Government—the Takachiho-Kan and Naniwa-Kan—are of the fastest and most heavily armed type, and are regarded as possessing the most trustworthy improvements yet embodied. In length they are 300 feet; breadth, 46 feet ; draught, 18½ feet; displacement, 3,600 tons. They have ram bows, and can discharge Whitehead torpedoes from four above-water ports, and are armed with two 10¼-inch guns, mounted on central pivot carriages as bow and stern-chasers; six 5 to 9-inch guns in broadside on central pivot carriages, and ten 1-inch machine guns, and two rapid-firing guns, besides for Gatlings mounted in the tops of the two military masts. All the guns except the Gatlings are on the upper deck, and carry steel shields attached to their carriages. Each ship has a protection deck, from two to three inches thick, extending fore and aft, with the sides curving below the water-line, and the hulls are minutely subdivided, Their engines are to develop about 7,500-horse power, and give a speed of 18 to 18½ knots.

"The proposed cruisers to be built for our navy are to be of the same length, three feet more beam, six inches less draught, and are to have a speed of 18 knots. The armament of the first will consist of two 8-inch and eight 6-inch breech-loading rifles. The secondary battery will consist of four 2.24-inch rapid-firing Hotchkiss cannon, four 1.85-inch revolving Hotchkiss, one 1.45-inch low-power Hotchkiss, and two short Gatlings, to be mounted on the lower decks, without protection by armor other than a light shield on the gun. She will carry a complete outfit for the Whitehead torpedo, suitable for six above-water launching tubes. The second cruiser is similar in size to the above, except that the main battery will consist of twelve 6-inch guns mounted on the open deck, on central pivot carriages, so disposed in sponsons and recessed ports that four guns may fire in a line of the keel at the bow and stern. The American designers have no doubt adopted the very best points in the Japanese cruisers, and added such of their own as will increase the efficiency of the ship.

"The Brazilians have recently received a new ship from England. She is a ship-rigged, twin screw, armored turret ship, of the following dimensions: Length, 280 feet; breadth, 52 feet; draught, 18 feet; displacement, 5,000 tons; is built of steel, has many water-tight compartments, and is sheathed with wood and copper as high as two feet above the water-line. She has a ram and five Whitehead torpedo ports. The armament consists of four 9-inch twenty-ton Armstrong guns, mounted with hydraulic gear into two *ęchelonned* turrets, four 5¾-inch Armstrong guns on Vavasseur carriages, mounted on the upper deck, two firing right ahead and two right astern, and fifteen Nordenfeldt guns. Her engines are of the three-cylinder compound type. With six out of eight boilers, her speed was 15.8 knots. With one screw, the speed was 11.5 knots, with fifteen degrees helm angle.

"The Italian Government has procured from England a steel cruiser, schooner-rigged, similar to the Esmeralda, but rather larger, having the following dimensions: Length, 280 feet; breadth, 42 feet; draught, 18½ feet; displacement, about 3,100 tons. She has a ram bow, and three under-water launching tubes for Whitehead torpedoes. Her armament consists of two 6-inch breech-loading rifles, mounted as bow and stern-chasers, loaded and worked by hydraulic gear, six 6-inch guns on central pivot carriages, mounted in broadside, two 6-pounder rapid-firing guns, and Hotchkiss and Nordenfeldt machine guns. The guns are protected by heavy steel shields attached to the carriages; the light guns aloft are mounted in small revolving turrets. There are twin screws, and the speed developed was 17.5 knots. The engines and boilers are of the Esmeralda type. The coal supply is 600 tons, good for 5,000 miles at 10 knots. She is named the Giovanni Bausan.

"In the fast-cruiser line, the French have built a number of twin-screw armored gunboats. One, the Acheron, launched last spring, is of the following dimensions: Length, 181 feet; breadth, 40 feet 4 inches; draught, 11 feet 10 inches; displacement, 1,640 tons. She carries a 10½-inch gun in a barbette turret forward, and two 3.9-inch guns amidships, one on each side. The bridge reaches over them, and the sides tumble home, to give each a full semi-circle of firing arc. The whole water-line is belted with 9½-inch armor. The speed will be 13 knots. Three others of similar design are building.

"Another class, known as cruising torpedo ships, are now building, identical in design. The Condor, the first of this type, has the following dimensions: Length, 229 feet; breadth, 29 feet; draught, 14 feet: displacement, 1,260 tons. She has a swan-breasted ram bow, and five above-water torpedo launching tubes between decks, two on each broadside, and one as a stern-chaser. Besides, she has five 3.94-inch guns, one of which is a stern-chaser, under the poop; two are bow-chasers under the forecastle (firing from ahead to the beam), and two more are in barbette half-turrets abreast the smokestack, and are protected from plunging fire by the bridge, which extends over them. There is an armored deck, reaching fore and aft, protecting the machinery, magazine, and steering geer, and the ship is divided into water-tight compartments above the armored deck. She has twin screws, and her estimated speed is 17 knots.

"Another remarkable vessel is the Milan, to be employed solely as a scouting vessel. She is built of steel, and is very light, and has a swan-breasted ram bow. She is unprovided with torpedoes. Her length is 303 feet; breadth, 32 feet 10 inches; draught, 9 feet 10 inches forward, and 15 feet 1 inch aft; displacement, 1,050 tons. Her armament consists of five 3.9-inch breech-loading rifles on hydraulic carriages—one on the bow, one on the stern, and the others on the broadside, on shifting pivot carriages, to fire on either side—and eight 1½ Hotchkiss guns. She has twin screws, each worked by two compound tandem engines. On her trial she made 18.4 knots in a rather rough sea, developing 4,132-horse power. The trial proved her the fastest man-of-war in existence.

"Two of the new German vessels of about 2,400 tons are the Alexandrine and Arcona, sister ships. They belong to the class of unarmored cruiser-corvettes, are bark-rigged, and have a two-bladed hoisting screw. Their dimensions are as follows: Length, 223 feet; breadth, 41 feet; draught, 16 feet 5 inches; displacement, 2,370 tons.

They are built of iron, sheathed with a double layer of teak, and coppered. The armament is ten 4.1-inch rifles, four machine guns, and one torpedo tube. The speed will be from fourteen to fifteen knots. The Germans have also added a large ship, named the Oldenberg, of 5,200 tons, to their Baltic fleet. She is heavily armored with eight 9.4-inch guns, four 5.9-inch guns, besides three 2¾ Hotchkiss guns, and two 3.1-inch boat guns. There are torpedo tubes and a ram bow. The central redoubt is protected by plates of 12.9 inches. She has twin screws, and compound engines aggregating 3,900-horse power each, with four cylinders. She will be 14 knots.

"England, of course, is earnestly engaged in endeavoring successfully to maintain her ancient superiority on the sea. Besides the colossal battleships—three of which, the Renown, Sanspareil, and Benbow, are the largest vessels laid down for the English navy since the Inflexible, twelve years ago—she is constructing five ships of the belted-cruiser class. They are of steel, of the following dimensions: Length, 300 feet; breadth, 56 feet; draught, 21 feet amidships; displacement, 5,000 tons. Their armament will be two 18-ton 9.3-inch guns, and ten 4-ton 6-inch, the latter mounted on the upper deck between the heavy guns, with steel shields attached to the carriages. Eight Nordenfeldts and six rapid-firing guns are mounted on the main deck in half towers. They have four torpedo-launching carriages, and four torpedo tubes. An armored deck protects the machinery, aided by the coal. The engines are to work independent twin screws, and are to be of the triple expansion type, the first applied to a vessel in the English navy. Speed, 17½ knots; coal capacity, 900 tons. Two masts will carry fore and aft sails, and the tops are to be well protected. These ships are somewhat heavier than the new vessels recommended to the Navy Department, with a heavier armament, and the additional armor belt will increase their fighting qualities. The new class will be called the Orlando, Undaunted, Narcissus, Australia, and Galatea.

"The twin-screw ram and torpedo vessel Polyphemus is a novelty. She has no heavy gun armament, relying on her ram and torpedoes, forty in number, launched from above-water carriages or through the bow and from broadside underwater launching tubes, the recent trials showing that this may be done at any speed. Her speed is over seventeen knots. As the vessel is completely submerged, and depends upon artificial light and forced ventilation throughout her interior all the time, she must prove a very dangerous assailant to any vessel she may encounter. She is 240 feet long; beam, 40 feet; draught aft, 21 feet 3 inches. Two new vessels, rather larger, are to be laid down. As they will have an ordinary deck over their protecting turtle-back, with light and airy quarters for officers and men, and a greater coal-bearing capacity, they will possess independent cruising power, which the present Polyphemus was not intended to have.

"Another class of torpedo cruisers, called the Scout and Fearless, seems to meet with favor with the English naval authorities. The Scout is of the following dimensions: Length, 220 feet; breadth, 34 feet; draught, 14.5; displacement, 1,430 tons; speed estimated at more than 16 knots. She carries eleven launching tubes, ten above and one below water; also four 5-inch rifles, two on the forecastle and two on the poop. Her cost will probably be about $324,109. The design of the class of vessels is so satisfactory that seven others of 1,600 tons displacement have been ordered. They are called the Archer, Brisk, Cossack, Mohawk, Porpoise, Tartar, and one not named.

"Since March, 1885, the English have added 55 torpedo boats to their fleet, several having been purchased in other countries and the remainder built in England. The dimensions of some of them are: Length, 113 feet; beam, 12 feet 6 inches; draught, 2 feet forward and 6 feet aft. They are fitted with three launching tubes; two in the bow are fixed, while the third, near the stern, can be trained from below deck and fired from the pilot house. Their speed is over 19 knots, and at moderate speed they can steam, without recoaling, 1,100 miles. Another lot is to be of larger and improved type. They are to be of steel, with fourteen water-tight compartments, and will carry twenty tons of coal, which, at 10 knots speed, will enable them to steam 2,000 miles; estimated speed, 19 to 20 knots. They are to be fitted with five torpedo tubes, and will carry two Nordenfeldts. A new class called torpedo hunters are large and quick turning. One building is 150 feet long, 220 tons displacement, and will steam 18 knots. She will be fitted with four torpedo tubes, firing ahead, on the bow and astern.

"The French are building a large number, many suitable to proceed through the canals and inland waters of France, thereby enabling them to be transferred from one sea to another. Some of these boats were able to keep the sea and accompany the French squadron during their entire cruise, and upon one occasion they continued their voyage when the armed vessels were obliged to seek harbor. Their speed was from 14 to 16 knots in heavy weather, while that of the big ships was reduced from 14 to 7 knots.

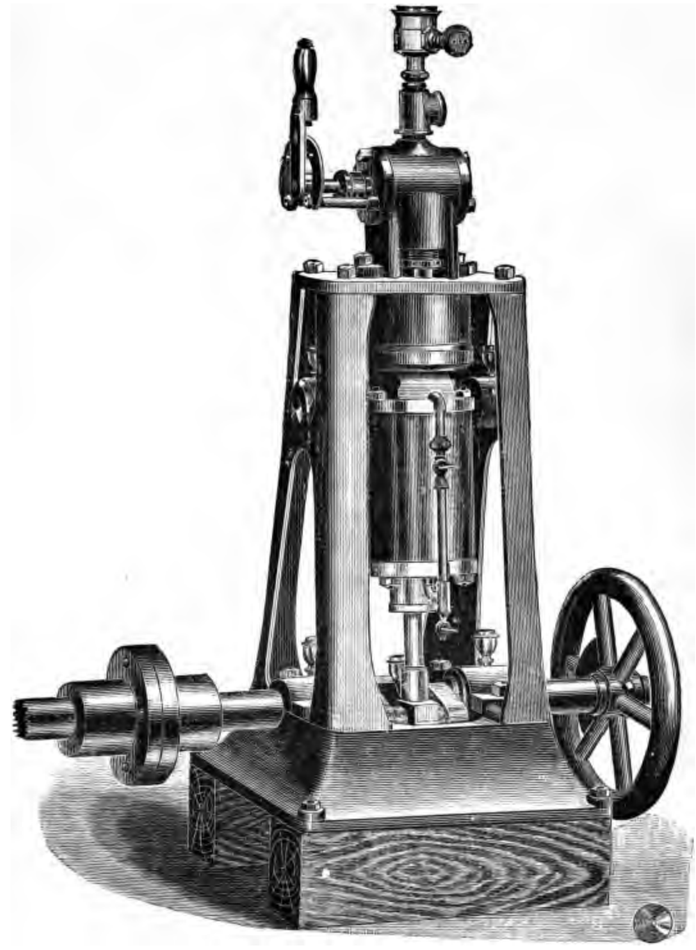
"Germany is making a feature of the torpedoes and torpedo boats for coast defence. They are adding largely to the number of boats of large size and of improved design. She will soon have a fleet of 150, and those built by the Germans have given fine results. The latest types of German boats are 109 feet 5 inches long, 11 feet 7 inches wide, and displace 75 tons at a draught of water 6 feet 2 inches. They launch 14-inch torpedoes from two tubes, are masted, and can travel with sail power only. They carry a large quantity of coal (22 tons), which enables them to steam 3,000 miles at eleven knots. They have comfortable quarters for officers and crew. They are fitted with a cooking stove, a Normandy condenser, two Hotchkiss guns, and an electric search-light. Their cost complete is only $50,000.

"Austria is having built in England two steel torpedo boats of the following dimensions: Length, 135 feet; beam, 13.75 feet. They are to develop 1,100 to 1,200-horse power and are to have a speed of 24 knots when light and 22 knots when loaded ready for service.

"The Turkish Government has ordered six torpedo boats in France. Dimensions: Length, 101.7 feet; beam, 11.07 feet; draught, 5.7 feet; displacement, 42 tons. They are to be fitted with two torpedo tubes in the bow and are to carry a spar torpedo as well. Upon trial one of the boats, carrying twenty-four persons, made 20.3 knots over the measured mile.

"With that spirit of enterprise characteristic of the Japanese, the ancient empire is pushing to the front as a naval power. Besides the fine iron-clads she possesses, she has contracted for a seagoing torpedo boat, with twin screws, of exceptionally large dimensions and novel design. The length is 166 feet; beam, 19½ feet; and it will have a speed of 19 knots. It will carry several machine guns, in addition to the four discharging tubes for Whitehead torpedoes."

China has recently invested liberally in torpedo boats and also in torpedoes for defensive purposes,



Engine of Modern Steam-launch.

It is a matter of regret that the United States Navy has no torpedo boats, and that none of our ships of war now afloat are provided with these modern appliances of combat. Most of the inventors of torpedoes are Americans, but their inventions have found more ready adoption abroad than at home. With an abundant fleet of torpedo boats, with suitable fortifications, our harbors and channels protected by sunken torpedoes, and a goodly number of iron-clads, we can protect our now defenceless ports and bid defiance to other governments which at present may insult us with impunity.

INDEX.